Universal Synchrony Music

Telematic Music Composition for Twelve Performers and Conductor

A Dissertation Presented

by

Sarah Rose Weaver

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Music

(Composition)

Stony Brook University

May 2018

Stony Brook University
The Graduate School

Sarah Weaver

We, the dissertation committee for the above candidate for the
Doctor of Philosophy degree, hereby recommend
acceptance of this dissertation.

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Abstract of the Dissertation

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Universal Synchrony Music (USM) is an electroacoustic telematic composition by Sarah Weaver—in collaboration with the NASA Kepler/K2 Mission and NASA ArtSpace—exploring musical, technological, and metaphorical realizations of synchrony. Synchrony is defined as perception of alignment of distributed time and space components. Telematic music is live performance via the internet by musicians in different geographic locations. Sonification of data on stars and planets in the Kepler field 1000-3000 light years away is utilized for presence across distance, inherent expressions of multiplanetary habitable systems, and interactions for synchrony.

Concepts explored in USM include: interaction and harmonization with cosmic sounds; creating perception of synchrony across local and extreme distances; Kepler/K2 Missions' search for habitability as a search for synchrony; and cultural and human levels of synchrony. Data elements that have been sonified for USM are star and planet light curves, phase curves, surface gravity, insolation, magnitude, radius, temperature, celestial coordinates, period, transit depth, transit duration, solar planet ratio, distance from Earth, and orbital alignments with Earth. Musical concepts are realized through elements such as resonance, timbral synthesis, alignment of intervals and harmonies, orbital approach to time and contour, and spatialization. Surround sound enables the expansive experience of spatialized sonification of data, such as orbiting, constellations, and being inside of a habitable planetary system. The resultant synchrony of the piece is realized through synthesis of presence with these deep space systems, representations and intuitive transmissions of inherent synchronies, along with metaphorical realizations.

Kepler/K2 Mission Data Collaborators: Jon Jenkins - Analysis Lead for the NASA Kepler/k2 Mission, Senior Research Scientist, SETI Institute, NASA Ames Research Center. Professors William Welsh, Jerome Orosz, and Donald Short, Astronomy Department, San Diego State University. Madeline Huberth, Center for Computer Research in Music and Acoustics, Stanford University. Daniel Fabrycky, Assistant Professor, Department of Astronomy and Astrophysics, University of Chicago.
Sonifications Collaborator: Doug Van Nort, DisPerSion Lab, York University

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List of Performance Notes

1) Locations and Instrumentation
Location 1: In Western Hemisphere
4 instrumentalists (Range: SATB), 1 percussionist (drumset or multiple percussion including toms and cymbals)
Location 2: In Eastern Hemisphere
4 instrumentalists (Range: SATB), 1 percussionist (drumset or multiple percussion including toms and cymbals)
Location 3**:** In any geographic location
1 piano, 1 electronics, 1 conductor

Locations perform together live via JackTrip audio conferencing software and Ultragrid video conferencing software on 1Gbps Internet bandwidth (or contemporary equivalent technology).

2) Narrative

Universal Synchrony Music (USM) is an electroacoustic telematic composition by Sarah Weaver—in collaboration with the NASA Kepler/K2 Mission and NASA ArtSpace—exploring musical, technological, and metaphorical realizations of synchrony. Synchrony is defined as perception of alignment of distributed time and space components. Telematic music is live performance via the internet by musicians in different geographic locations. Sonification of data on stars and planets in the Kepler field 1000-3000 light years away is utilized for presence across distance, inherent expressions of multiplanetary habitable systems, and interactions for synchrony.

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3) Score Details
The score contains palettes of materials including music notation, text notation, graphic notation, gestures, structured improvisations, and sonifications. Perform the palettes in numerical sequence on cue by the conductor. Time length indications are approximate. The piece is composed with the expectation of latency between the locations. Perform the materials as written within the latency of the medium. All boxed text in the score is detailed in the performance notes.

4) Terms
Extensions (Palettes 3, 12): Improvisation that expands and intensifies the current material.
Attention Strategy (Palettes 2, 4, 5, 7, 9, 10, 13-15): Focus your attention on the given strategy and let this influence the improvisation. Attention strategy is a device from composer Pauline Oliveros.

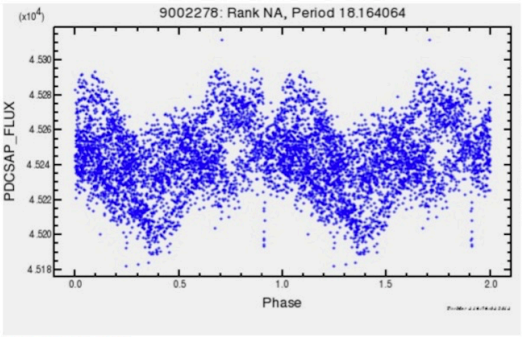
5) Sonifications
Sonification 1 (Palette 1): File: "koi_orbiting"
The file contains data on the orbits of Kepler area habitable planets in multiplanetary systems. The T0 data point is where each habitable planet aligns with Earth during its orbit. Scale the timing of the orbits so that the density of T0 data points are close enough together to create multiplicities. Play a meditation chime electronic sound at the T0 data point of each habitable planet. Pitch is highest for planets with fastest orbits, lowest for slowest orbits, within range of pitch C1-C7.

Sonification 2 (Palette 2): File: "kepler1"
The file contains data on light curves of stars from multiplanetary systems with habitable zones. Play stars individually using spectral harmonics shaped by the light curves. Each star should be 3-5 seconds in length. Pause 5-10 seconds between each star. Highest fundamental pitches closest to earth, lowest fundamental pitches furthest away.

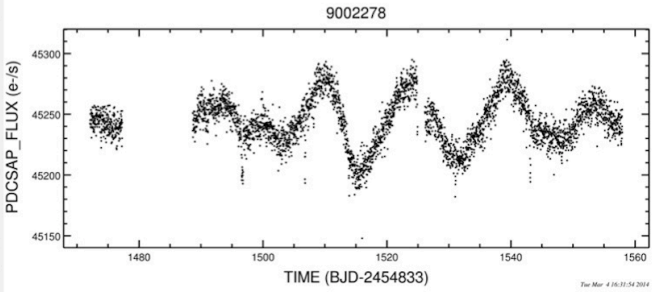
Sonification 3 (Palettes 4, 8): Files: "kepler1" "kepler 2" "kepler 3"
These files contain data on the stars of multiplanetary habitable systems. The three files are three Kepler areas in latitude sequence based on celestial coordinates. Play bright meditation chime electronic sound with harmonics for each star with sonified vibrato according to brightness. Perform with sonified time intervals between each star within range 30-90BPM to create constellations. Highest fundamental pitches closest to earth, lowest fundamental pitches furthest away.

Acoustic Instruments 1-4: Play these plots of Kepler 62 and 69 habitable planets as graphic notation.

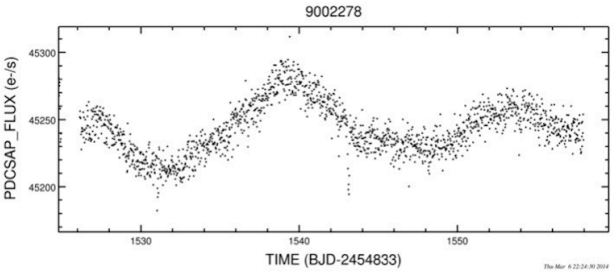
Kepler 62



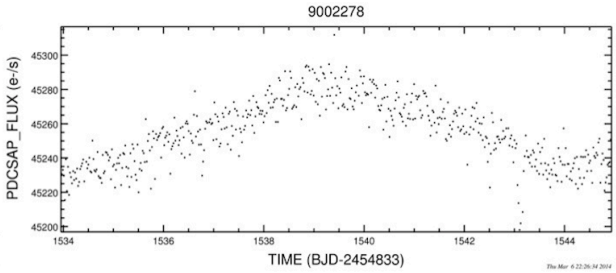
PHASE CURVE



LIGHT CURVE

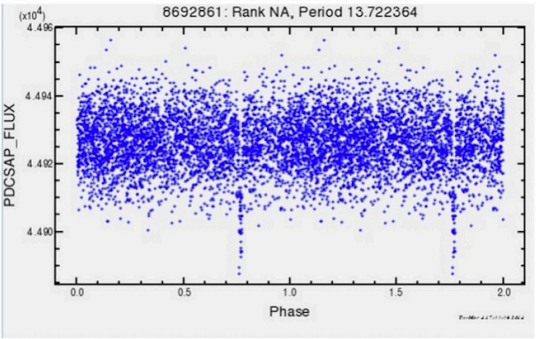


LIGHT CURVE ZOOM 1

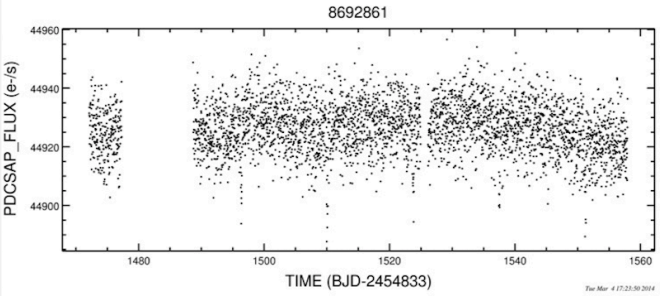


LIGHT CURVE ZOOM 2

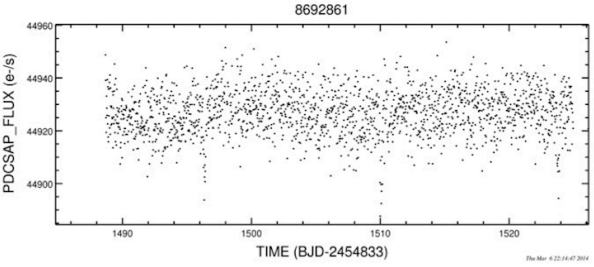
Kepler 69



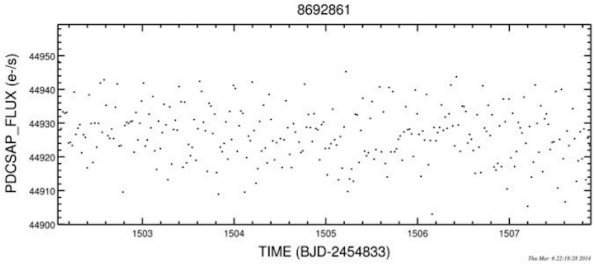
PHASE CURVE



LIGHT CURVE



LIGHT CURVE ZOOM 1



LIGHT CURVE ZOOM 2

Sonification 4 (Palettes 11-15)
Files: “kepler47 orbits”, “Table1_Kepler47d", "Kep47c-insolation", "Kep47d-insolation"
These are data files of the Kepler 47 binary star system, containing a habitable zone. There are five objects – two stars and three planets. Sonify the orbit of this system in a similar way to sonification 1, playing a chime at a T0 data point. Use the brighter chime with vibrato for the two stars, the non-vibrato chime for the three planets. Add the insolation sonification as brighter timbre and vibrato to the planets when they are insolated. Using the system parameters table, sonify the brightness of the stars and magnitude of the planets as volume and length of the object. The length per object is between a half second and two seconds. Sonify the pitches of the system within a major 10th, with option to transpose in sequence.

Max Patches for Reading and Filtering Data
Links to Max patch files from sonifications collaborator Doug Van Nort are included in appendix for the electronic performer(s). There are versions for data that includes scientific notation and data that is text only. Note the data should be formatted as tab delimited for these patches. The patches can be utilized for the data and connected to individual performance software and hardware.

6) Lexicon for Conductor Gestures
The gestures are a combination of Soundpainting originated by Walter Thompson, traditional conducting, and original gestures by Sarah Weaver. They can be utilized at any time throughout the piece. At the discretion of the conductor, gestures can be utilized in **Split Body:** musicians on the left side of the conductor follow the left side of the body, musicians on the right side of the conductor follow the right side of the body. Gestures can also be utilized in **Location Body:** establish three areas in front of the body to indicate the three geographic locations of the musicians, musicians respond to gestures given to their location.

Palette
Meaning: Number of section (corresponds with rehearsal numbers).
Gesture: Fist of right hand in palm of left hand with fingertips facing up. Then a number is shown in the right hand to indicate section.

Cue
Meaning: Enter, Exit.
Gesture: Enter - slightly cupped hand, palm up, fingers pointed towards the performer.
Exit - circular motion of the hand from palm up to palm down while closing the fingers.

Group
Meaning: Indicates next gesture is for the Group only.. Group 1 = Location 1, Group 2 = Location 2, Group 3 = Location 3.
Gesture: Two fists facing body, one on top of the other, followed by a number.

Volume Fader
Meaning: Level of dynamics.
Gesture: A 'v' is formed with the first two fingers in the hand. Up is loud, down is soft.

Density Fader
Meaning: Amount of silence between sounds.
Gesture: Fingers facing away from body, palms facing each other, hands move horizontally. Hands close together indicates high density, further apart indicates low density.

Shapeline - Pulseline
Meaning: Musically respond to the shapes and pulses shown by the conductor.
Gesture: Shown with the arms and full body. The neutral position is arms at the sides of the body.

Dimension Point
Meaning: Improvise another layer to the current material.
Gesture: One finger pointing to a musician.

Pitch Complex Fader: Long Tone, Drone, Gliss, Vibrato, Pulsate, Hits, Pointillism, Resonance, Timbre, Harmonics
Meaning: Complex Faders contain multiple gestures within one overall fader.
Gesture: Pitch Complex Fader is initiated by one or two hands with palm down, six inches to the side of the body, fingers pointing towards the body. Location on vertical plane indicates pitch range high to low relative to instrument. Use any of the following gestures:
Long Tone
Meaning: Sustained pitch.
Gesture: Flat hand, palm down.
Drone
Meaning: Long tone undulations centered in the pitch level indicated.
Gesture: Flat hand, palm down, circular motion.
Gliss
Meaning: Glide between long tones in range shown.
Gesture: Flat hand, palm down, move vertically.
Vibrato
Meaning: Oscillation of micro pitch variations.
Gesture: Flat hand, palm down, moving up and down quickly.
Pulsate
Meaning: Accent the pitch as shown.
Gesture: Flat hand, palm down, moving up and down in steady pulse.
Hits
Meaning: One sound on cue within pitch range shown.
Gesture: Two hands, fingers facing ensemble, first three fingers make a point. Wrist movement gives hit timing in the fingers.
Pointillism
Meaning: Staccato sounds in high density.
Gesture: Fist.
Resonance
Meaning: Increase fullness of sound.
Gesture: Curved hand, palm down

Timbre
Meaning: Change the quality of the sound.
Gesture: Curved hand, palm facing body
Harmonics
Meaning: Harmonics and multiphonics.
Gesture: Fingers spread, palm facing body.

Space Complex Fader: Hold, Extend, Multiply, Constellate, Loop, Spectralize, Gravitate, Merge, Synchronize
Meaning: Complex Faders contain multiple gestures within one overall fader.
Gesture: Space Complex Fader is initiated by left hand with palm down, fingers pointing away from body, arm extended. Then the right hand shows any of the following gestures:
Hold
Meaning: Play a long tone on the current pitch for the duration of the gesture.
Gesture: Right palm placed on top of left palm.
Extend
Meaning: Play an elaboration based on the current material.
Gesture: Right palm placed palm up on top of left palm.
Multiply
Meaning: Based on current sounds in the ensemble, play an axis of rhythms that vary yet closely intersect. This can optionally be applied to pitch and timbre as well.
Gesture: Right fingers spread facing upwards, palm facing body.
Constellate
Meaning: Based on current sounds in the ensemble, play a sequence of 4-7 pitches that include steps, leaps, and variance of length between each sound within 30-90BPM. Utilize vibrato on each pitch.
Gesture: Right fingers spread facing upwards, palm facing away from body.
Loop
Meaning: Loop the current material for the duration of the gesture according to the loop length shown.
Gesture: Right palm facing down, hovering above left palm. Higher above left palm is longer loop, lower is shorter loop.
Spectralize
Meaning: Create a texture of discrete sounds from the current material.
Gesture: Right palm facing down, hovering above left palm, spread fingers of both hands.
Gravitate
Meaning: Move closer or further away from unison.
Gesture: Right palm facing body, fingers pointing down. Move right hand vertically. Higher is further from unison, lower is closer to unison.
Merge
Meaning: Blend current material into a homogenous texture.
Gesture: Right palm facing body, fingers pointing left.
Synchronize
Meaning: Create an alignment of the current materials.
Gesture: Right palm facing body, fingers pointing left, spread fingers.

Universal Synchrony Music
Appendix: Data Files for Sonifications of Kepler/K2 Area Stars and Planets

Download Files:
https://drive.google.com/open?id=1syMGXK-QY49mmBMZKm9vrMC1967pEb_1

Data Files:
koi_oribiting.csv
kepler1.csv
kepler2.csv
kepler3.csv
kepler47 orbits.rtf
Kep47c-insolation.dat
Kep47d-insolation.dat
Table1_Kepler47d.pdf

Max Patch Files of Doug Van Nort:
sonification_data_coll_read_V2.maxpat
sonification_data_coll_read_V2_noscience.maxpat
sonification_data_text_read_V2.maxpat
sonofication_data_text_read_V2_noscience.maxpat

Universal Synchrony Music

By Sarah Rose Weaver

***Conductor Gestures:**
Palette
Cue
Group
Volume Fader
Density Fader
Shapeline-Pulseline
Dimension Point
Pitch Complex Fader
- Long Tone
- Drone
- Gliss
- Vibrato
- Pulsate
- Hits
- Pointillism
- Resonance
- Timbre
- Harmonics

Space Complex Fader
- Hold
- Extend
- Multiply
- Constellate
- Loop
- Spectralize
- Gravitate
- Merge
- Synchronize

Telematic Music Composition for Twelve Performers and Conductor

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4 instrumentalists (Range: SATB), 1 percussionist (drumset or multiple percussion)
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*All boxed text in the score is detailed in the performance notes.

Approximate Length: 45 minutes

1 Time: 2 Minutes

Electronics: *Sonification 1: Alignment of habitable planets with Earth

2 ♩ = 60

Location 1

Instrument 1

2nd Time: Add improvisation duet with Instrument 1 Location 2. Continue playing written material.
attention strategy: gravitation

Instrument 2

Instrument 3

Instrument 4

Perc.

Location 2

Instrument 1

2nd Time: Add improvisation duet with Instrument 1 Location 1. Continue playing written material.
attention strategy: gravitation

Instrument 2

Instrument 3

Instrument 4

Perc.

Location 3

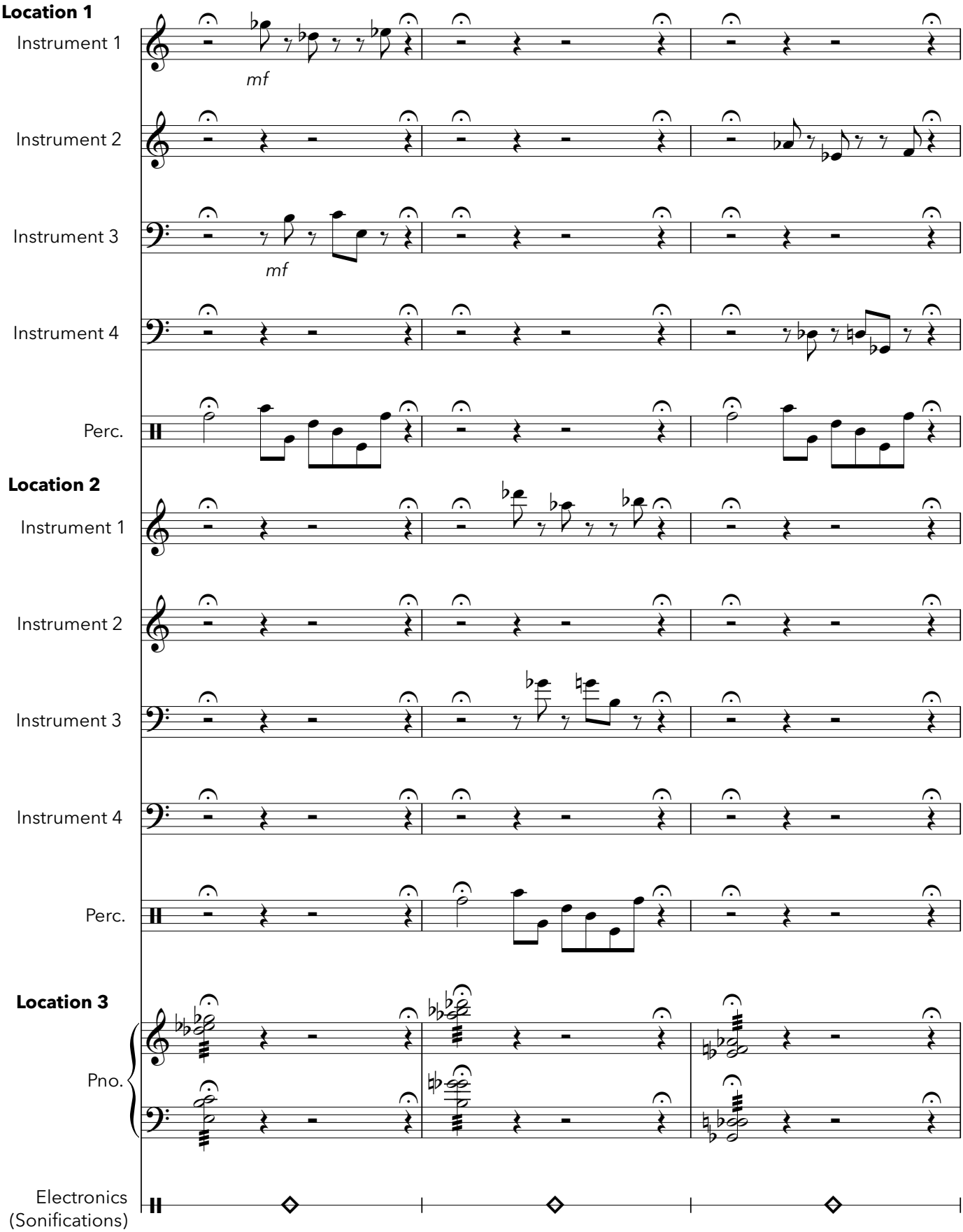
Pno.

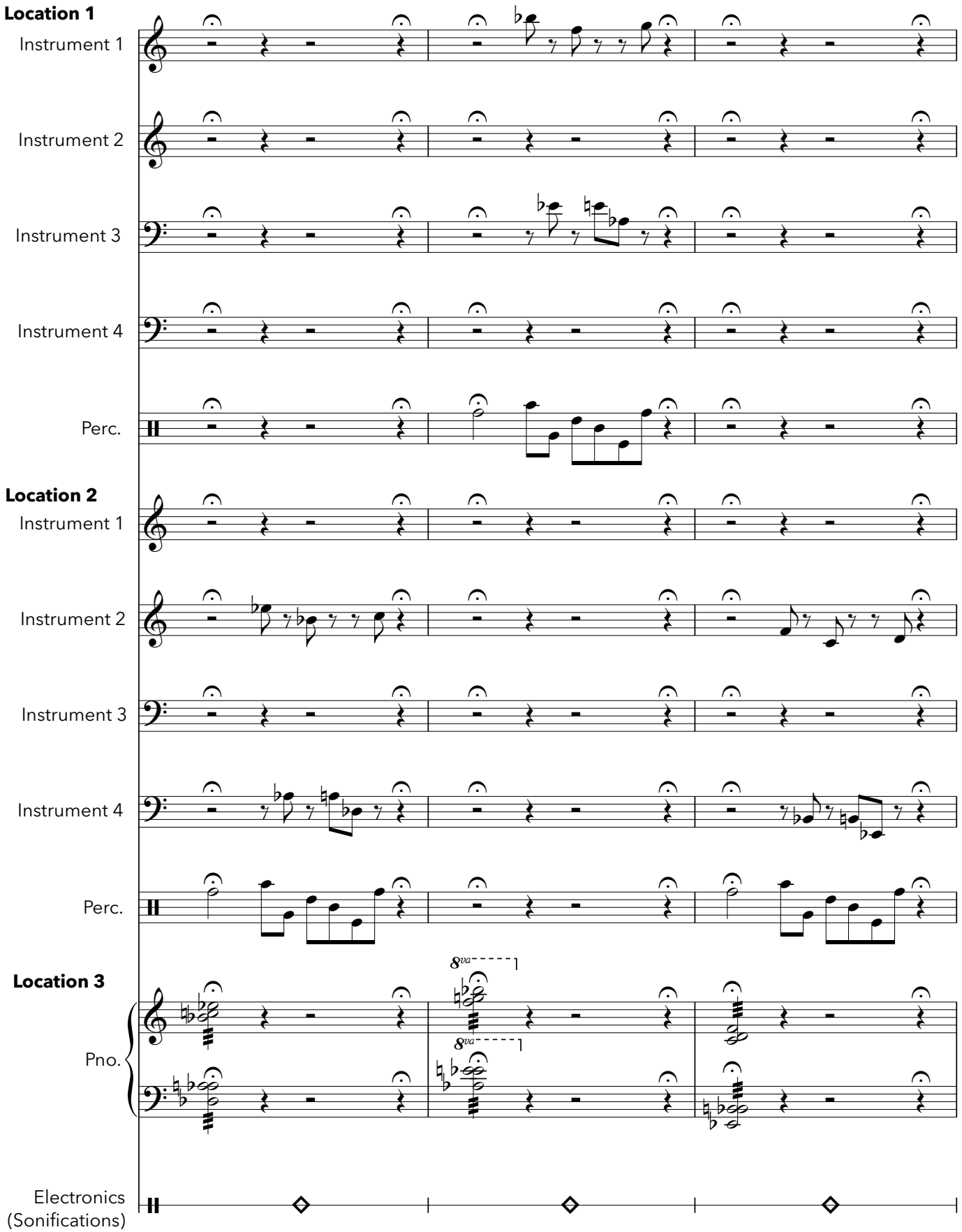
♩ = 60

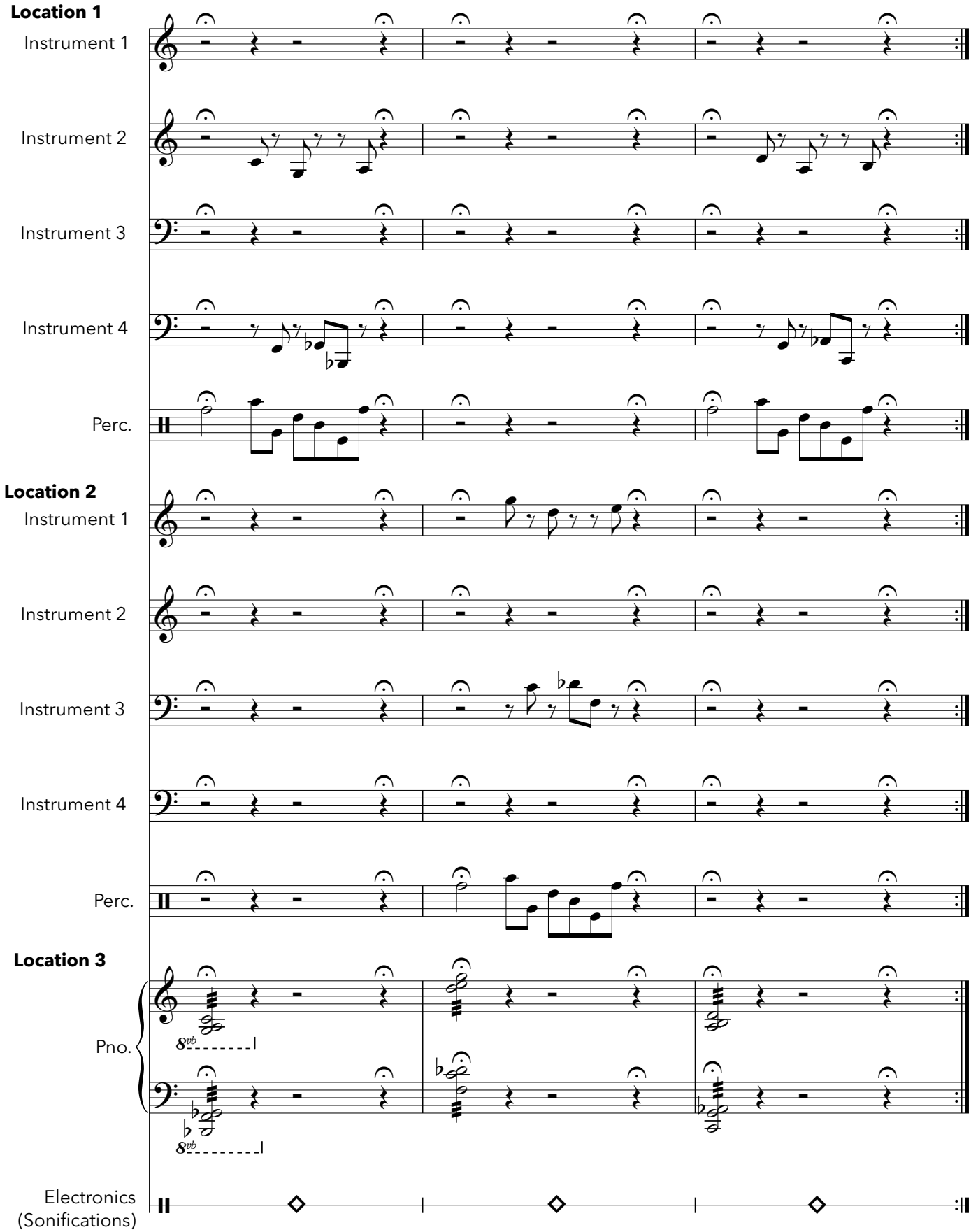
Electronics (Sonifications)

1st Time: Tacit

2nd Time: *Sonification 2: Light curves of stars from multiplanetary systems with habitable zones

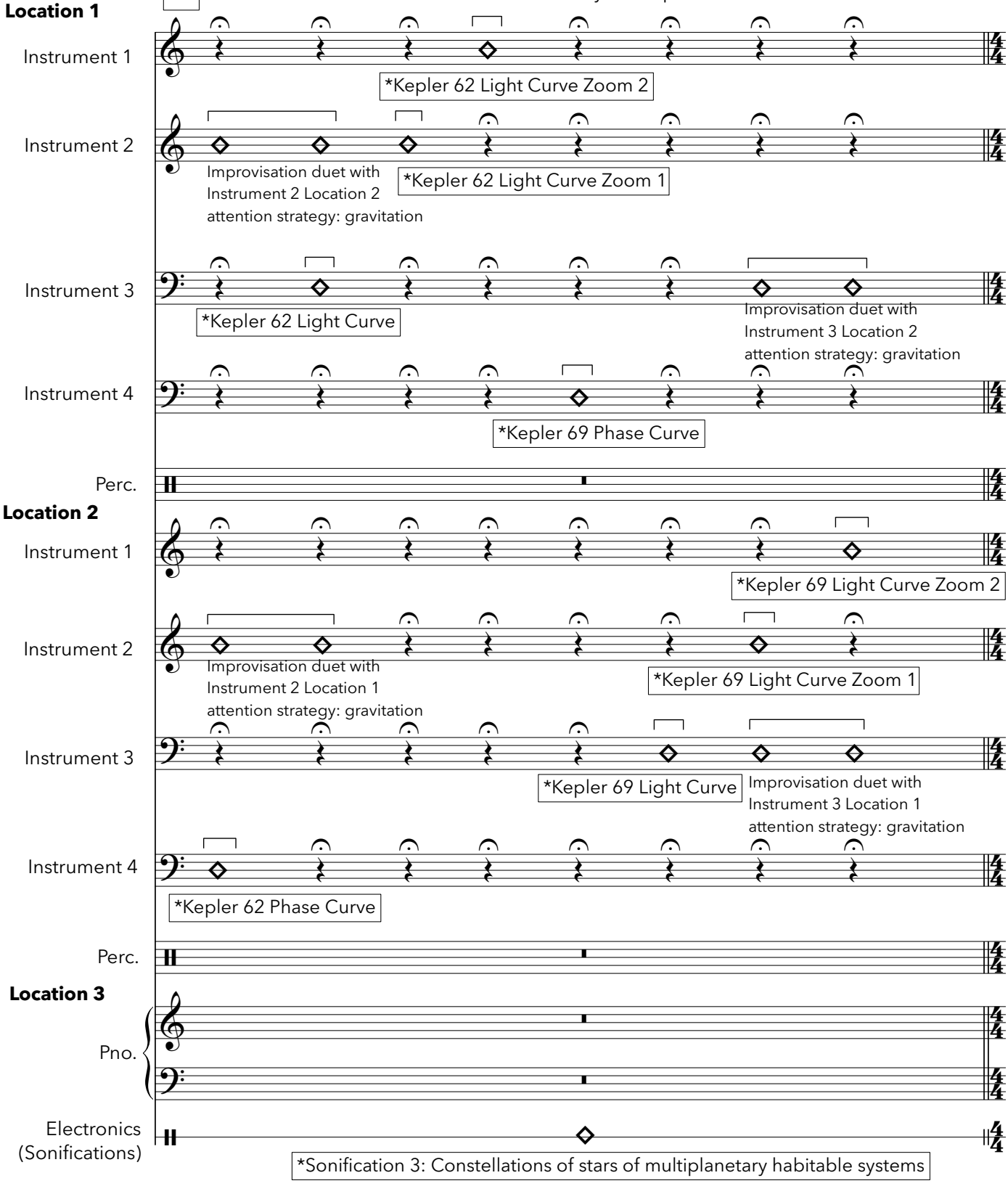

Location 1
Instrument 1
mf
Instrument 2
Instrument 3
mf
Instrument 4
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 3
8va
8va
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
8vb
8vb
Electronics
(Sonifications)

3 Time: 1 Minute Piano: Solo utilizing chords from palette 2 and extensions

4 Time: 3 Minutes
Conductor cues each fermata. Materials may overlap.

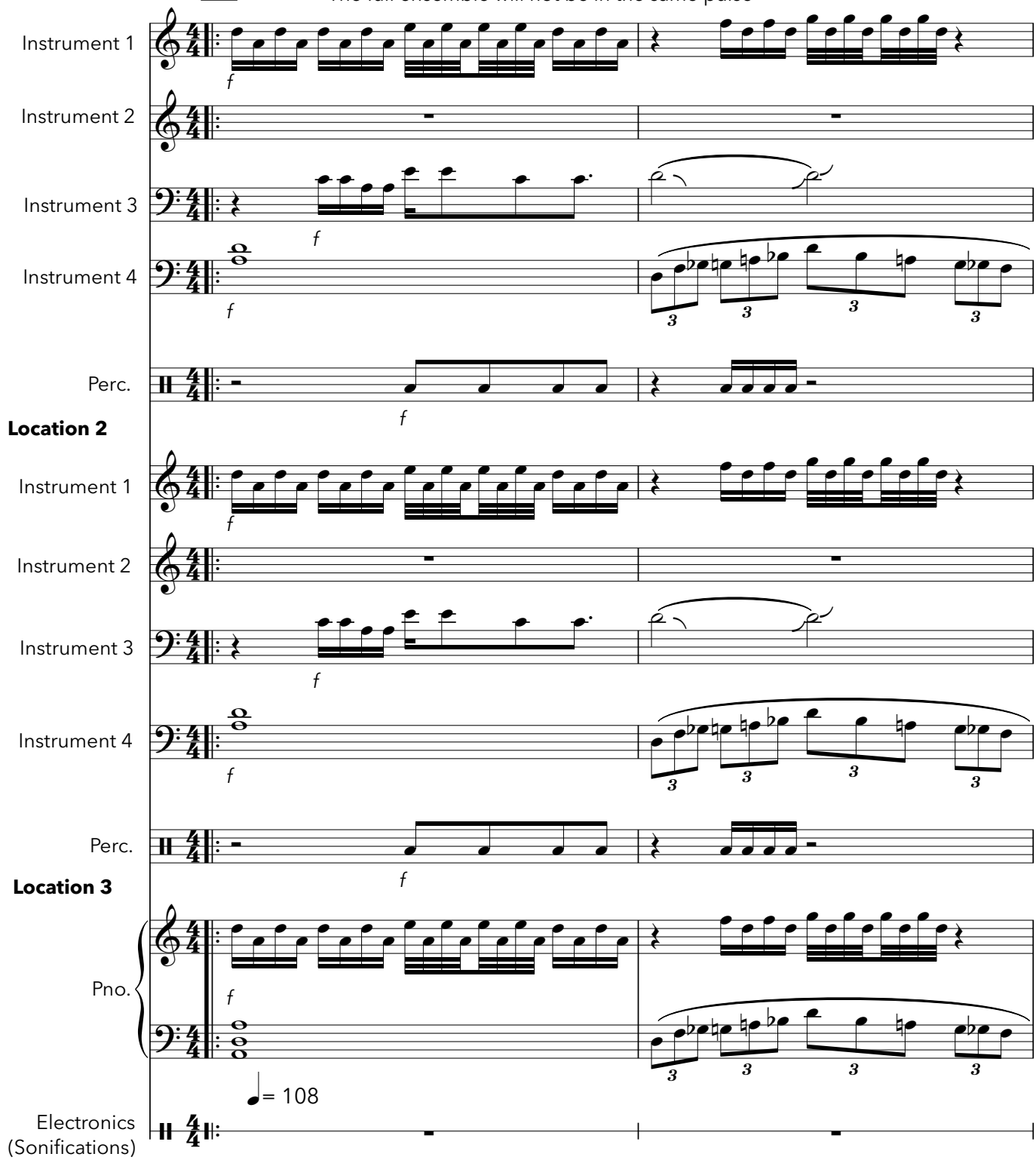


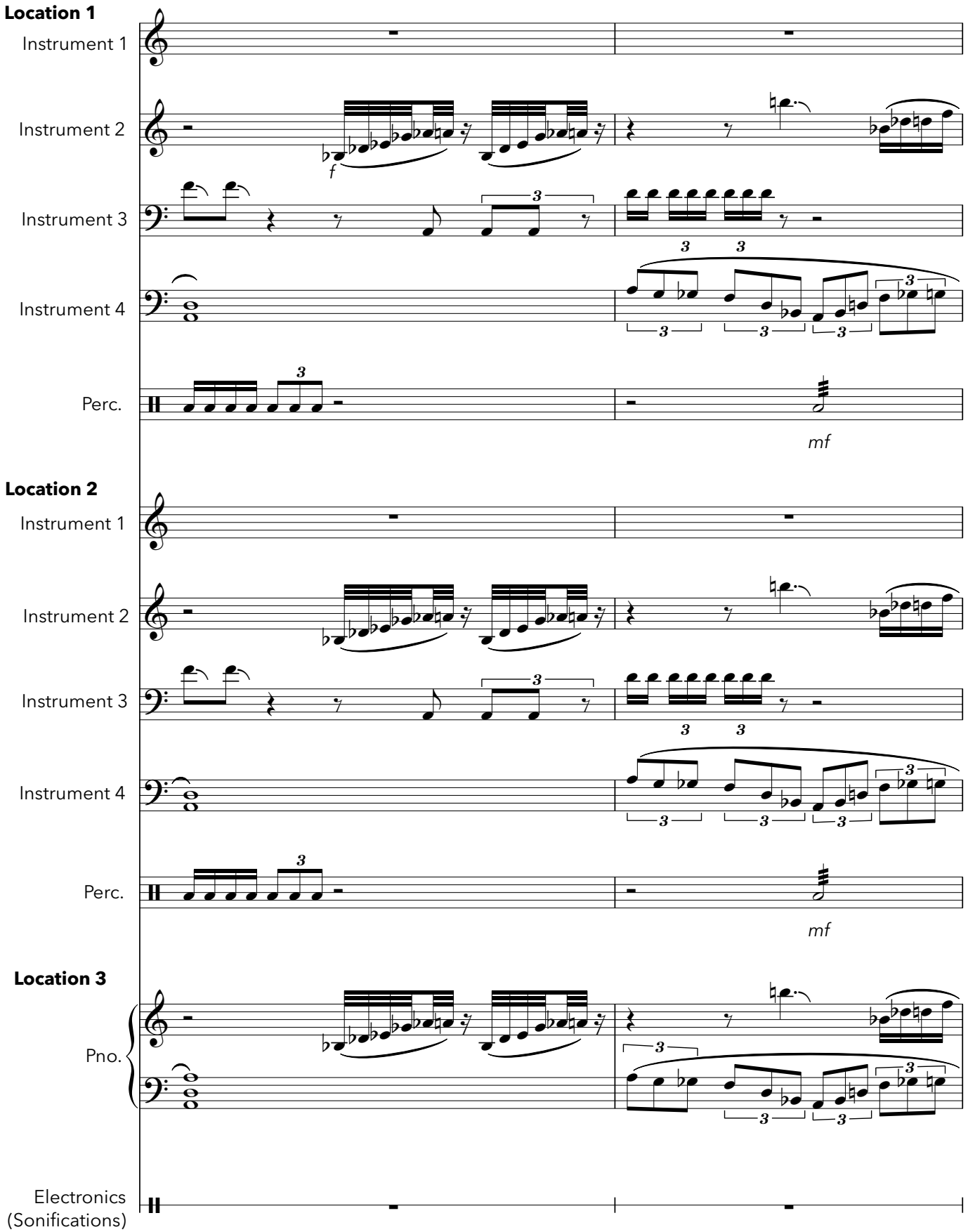
5 Time: 2 Minutes

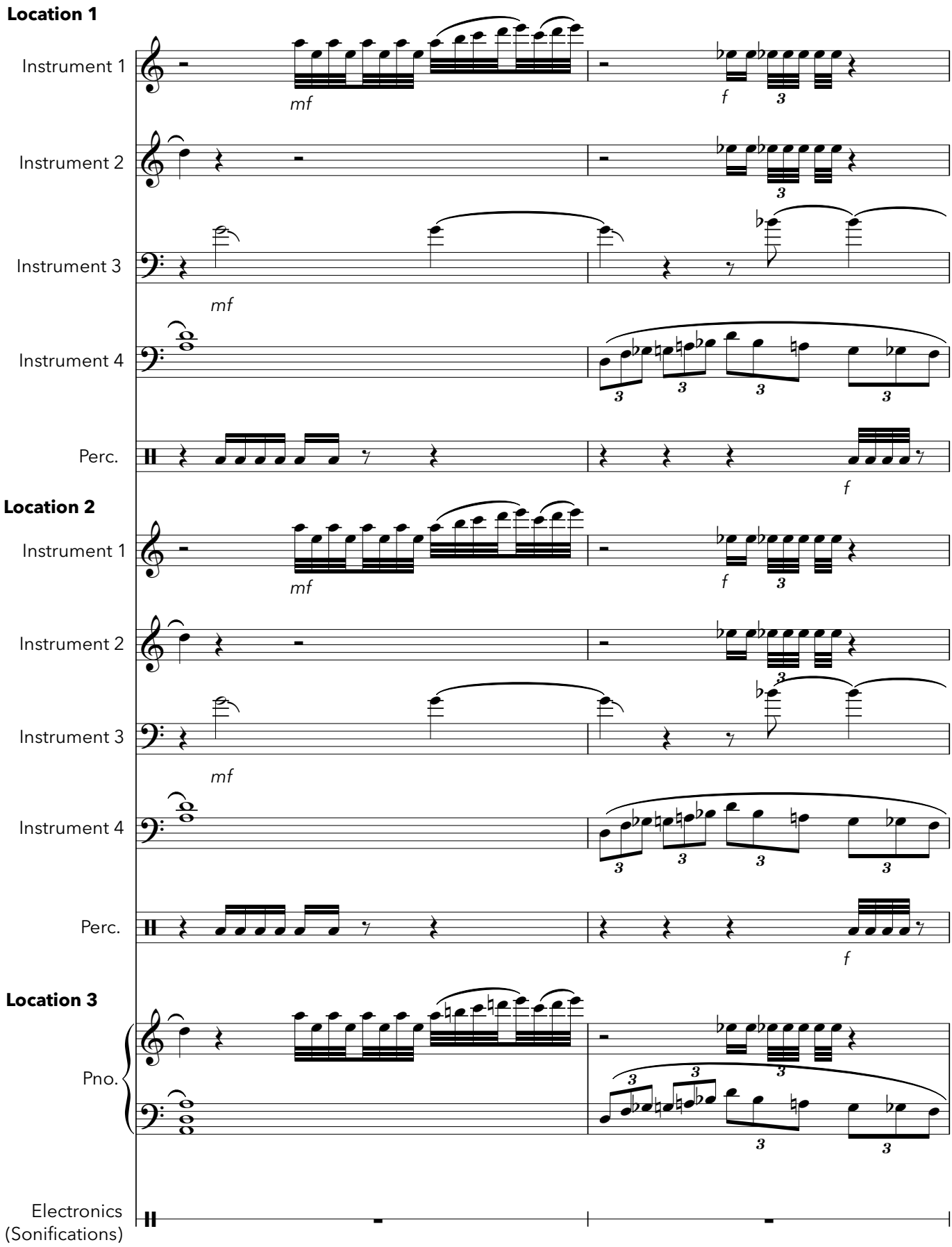
Instrument 4 Improvisation Duet
Locations 1 & 2: attention strategy: inner universe

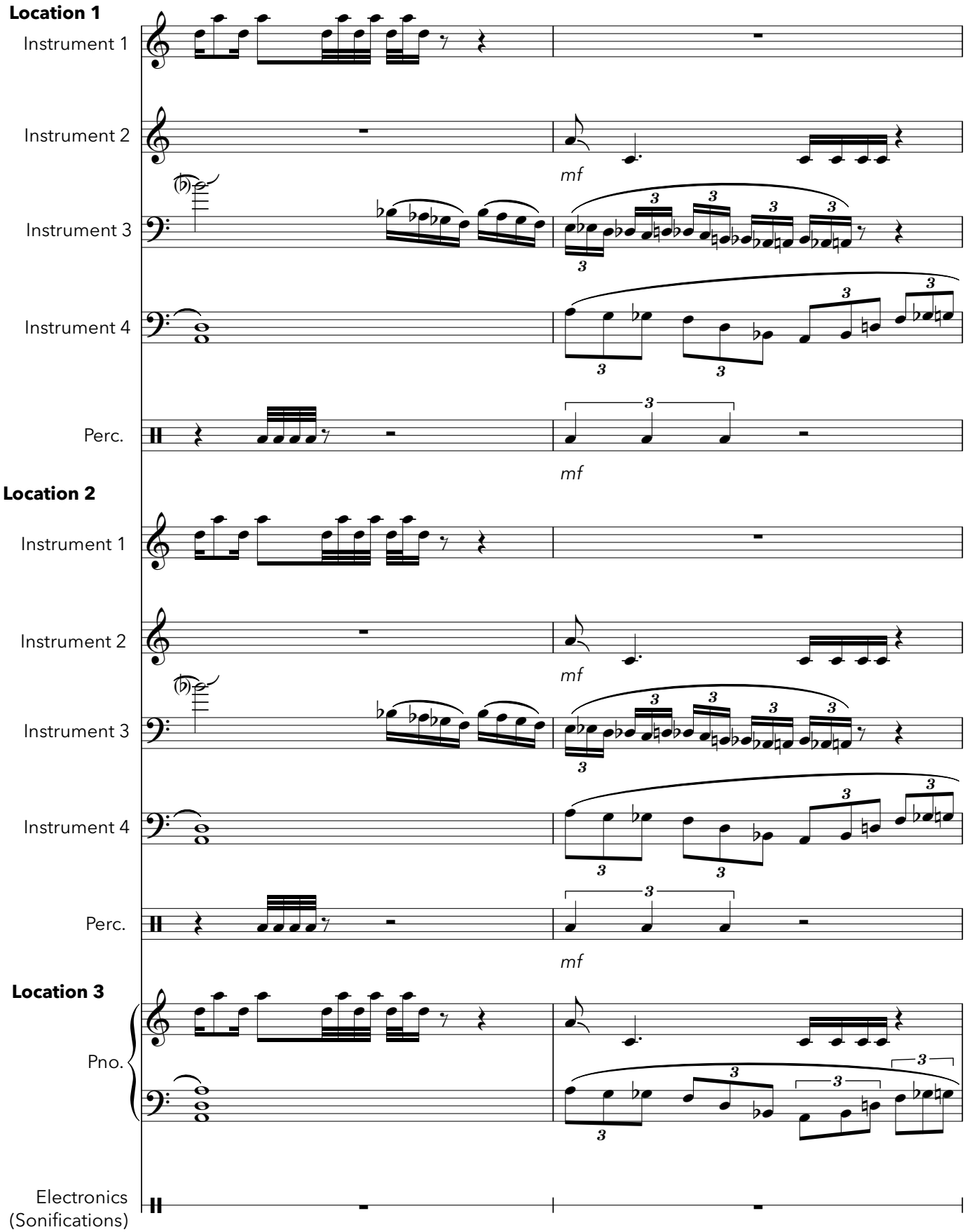
Percussionists Improvisation Duet
Locations 1 & 2: attention strategy: search for synchrony

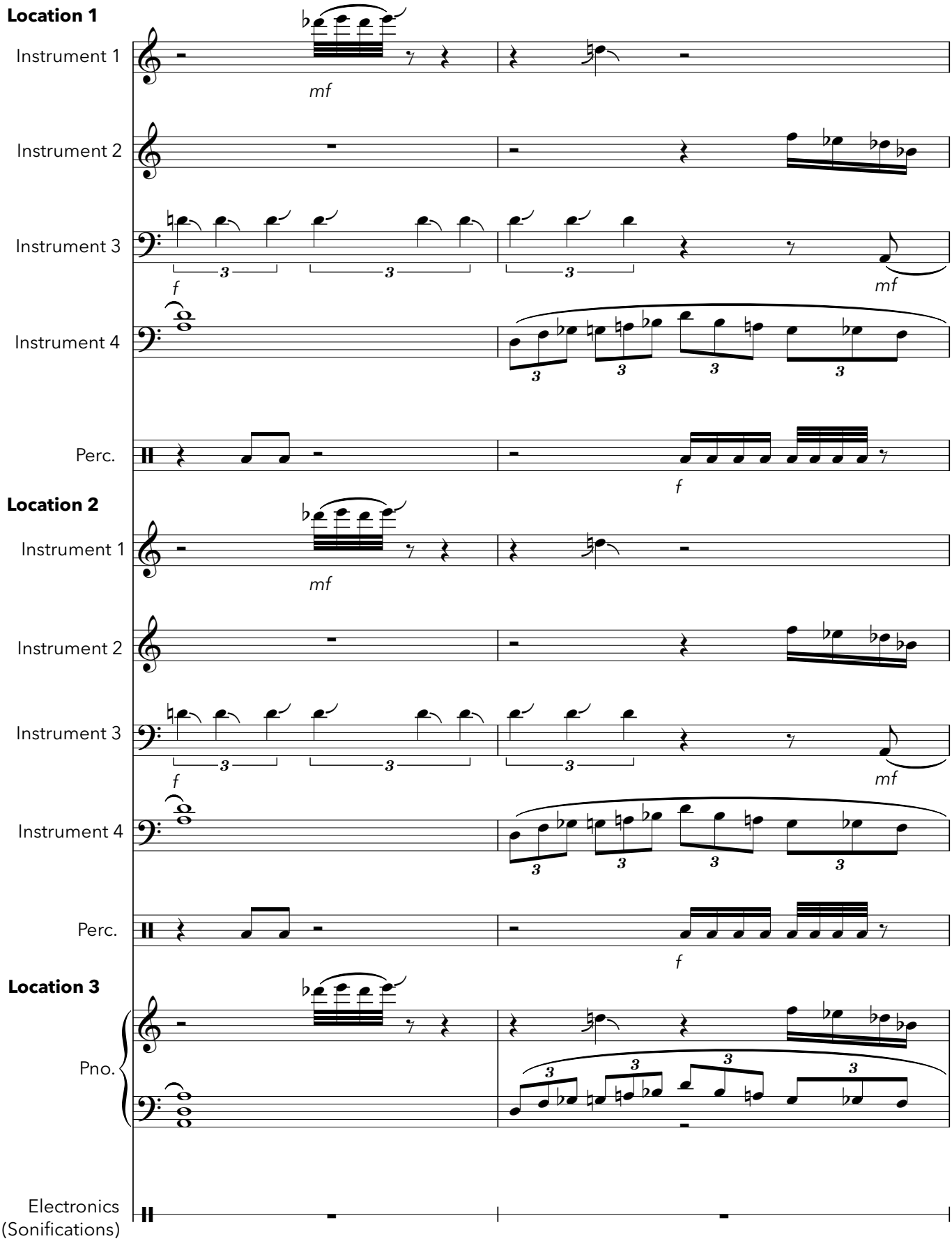
6 ♩= 108 Stagger Entrances of Locations, Maintain Tempo Within Location
The full ensemble will not be in the same pulse

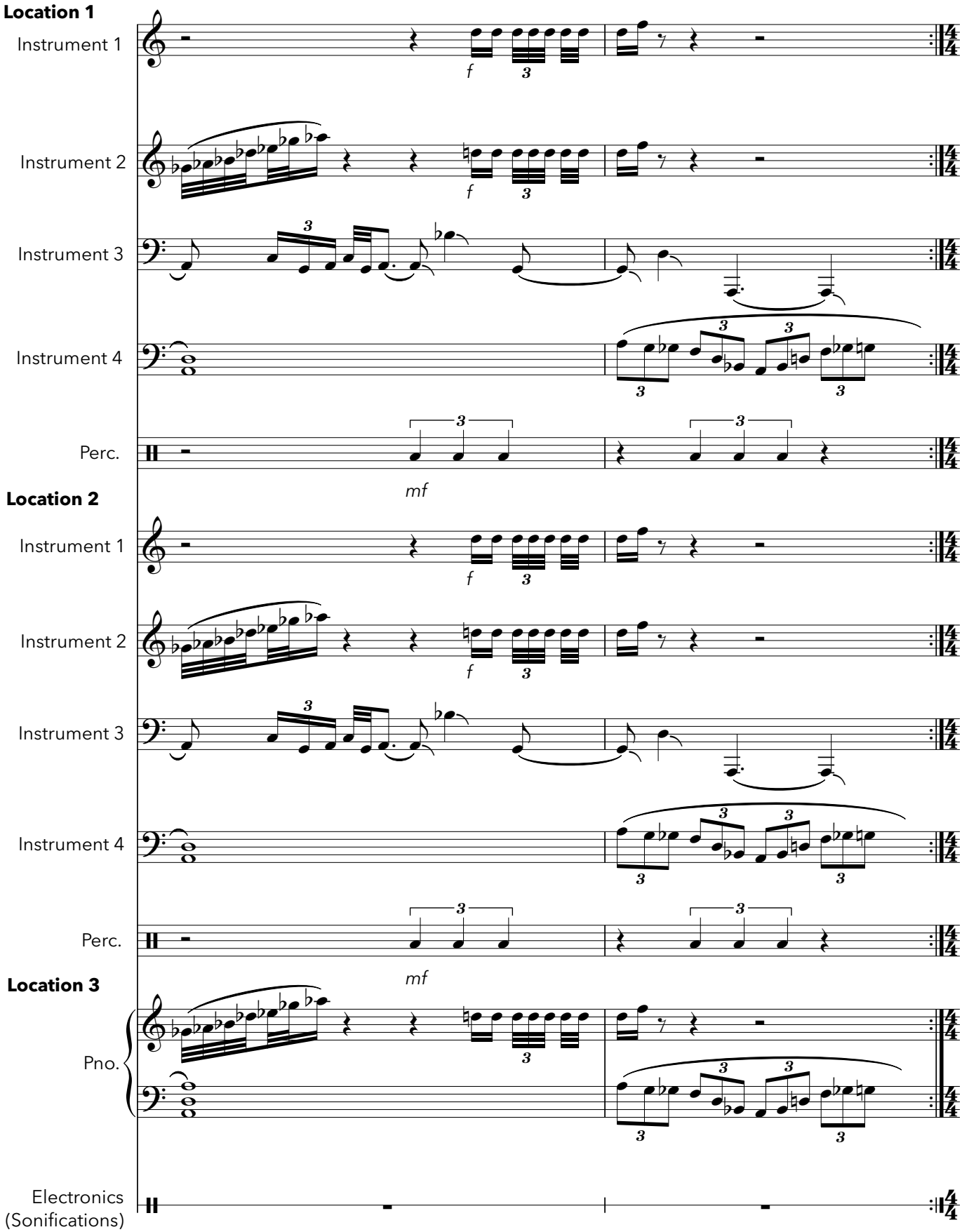



Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
f
mf
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
mf
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)
mf
f


Location 1
Instrument 1
Instrument 2
mf
Instrument 3
Instrument 4
Perc.
mf
Location 2
Instrument 1
Instrument 2
mf
Instrument 3
Instrument 4
Perc.
mf
Location 3
Pno.
Electronics
(Sonifications)

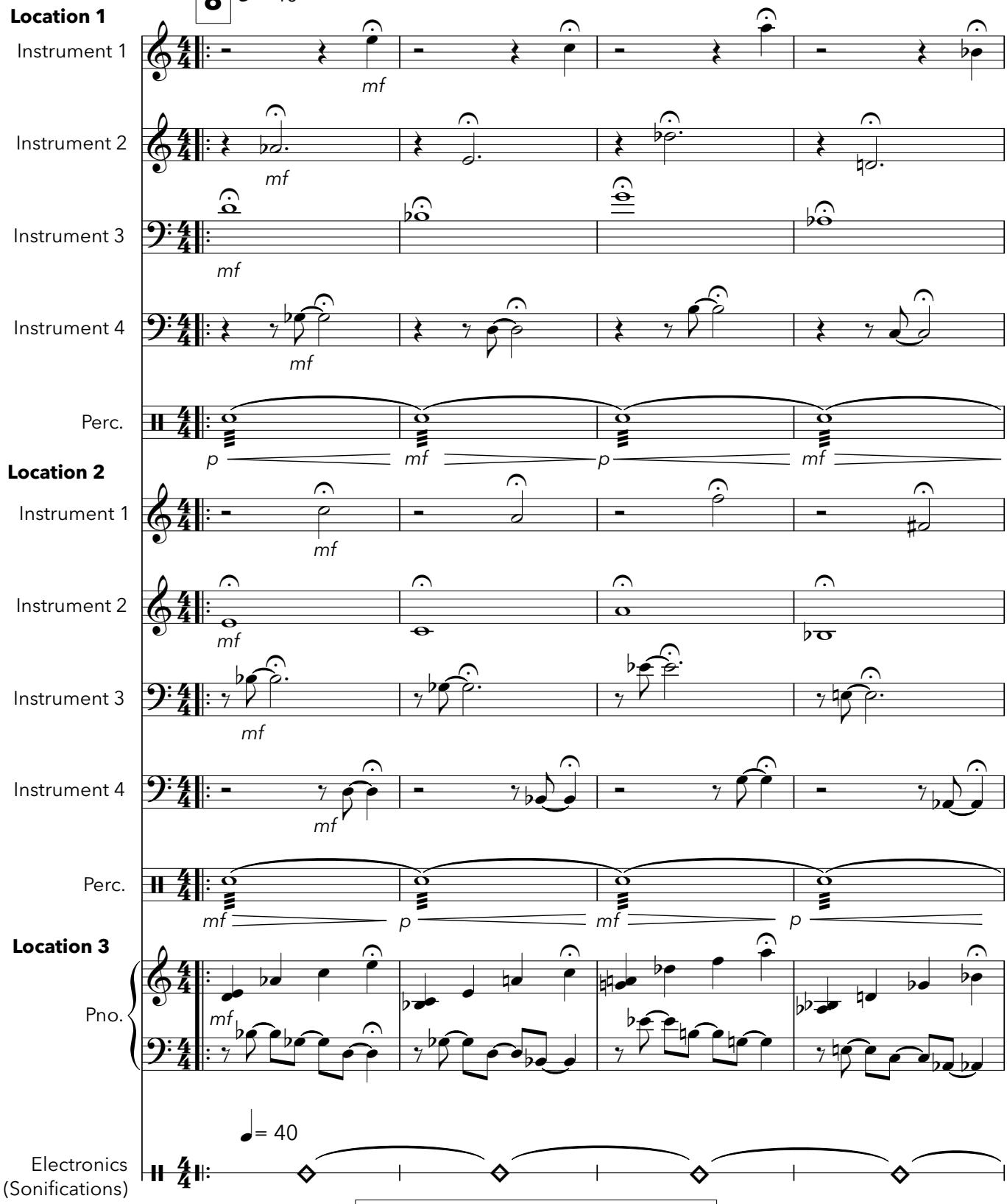

Location 1
Instrument 1
mf
Instrument 2
Instrument 3
f
mf
Instrument 4
Perc.
f
Location 2
Instrument 1
mf
Instrument 2
Instrument 3
f
mf
Instrument 4
Perc.
f
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
f
mf
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
mf
Location 3
Pno.
Electronics
(Sonifications)

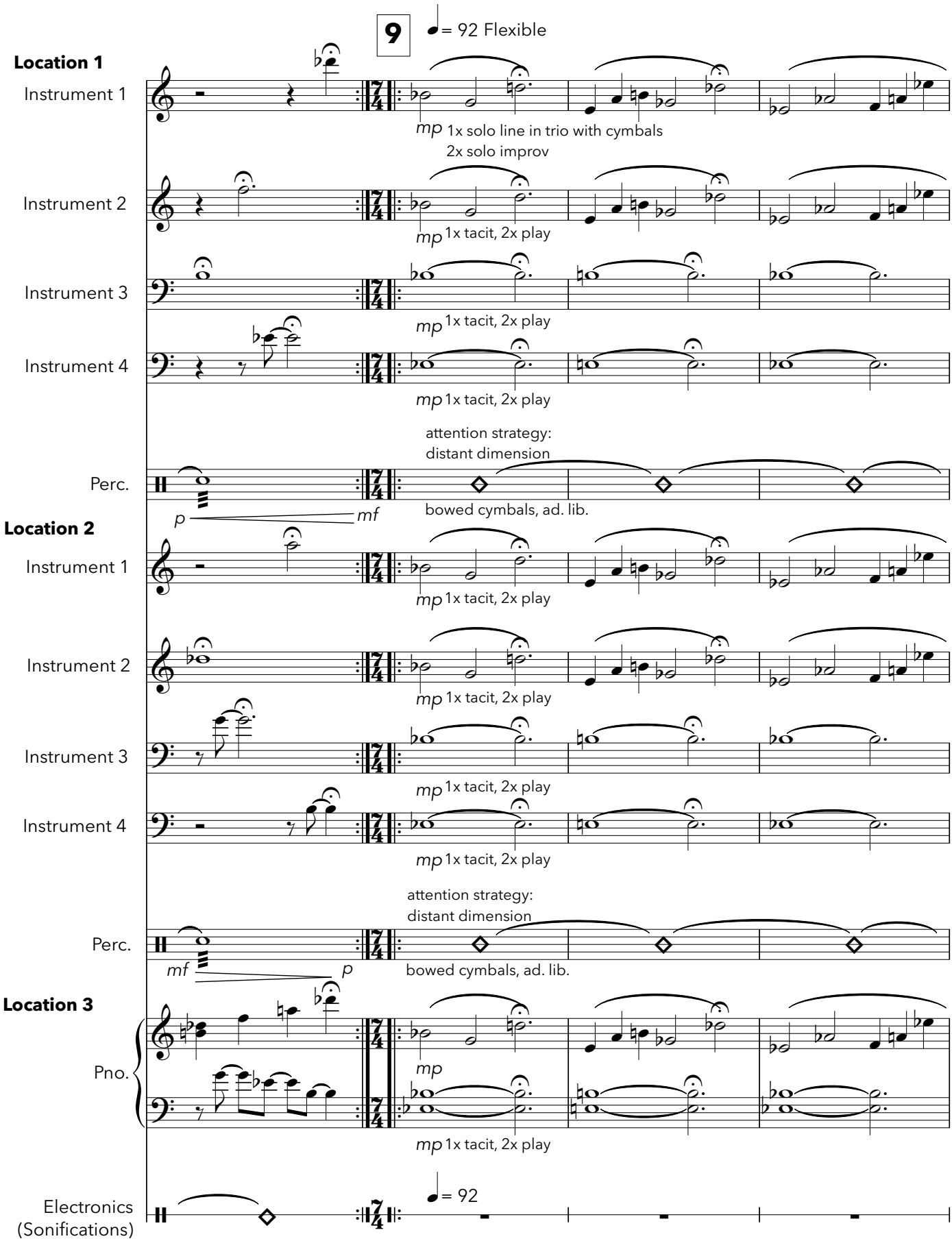
7 Time: 3 Minutes

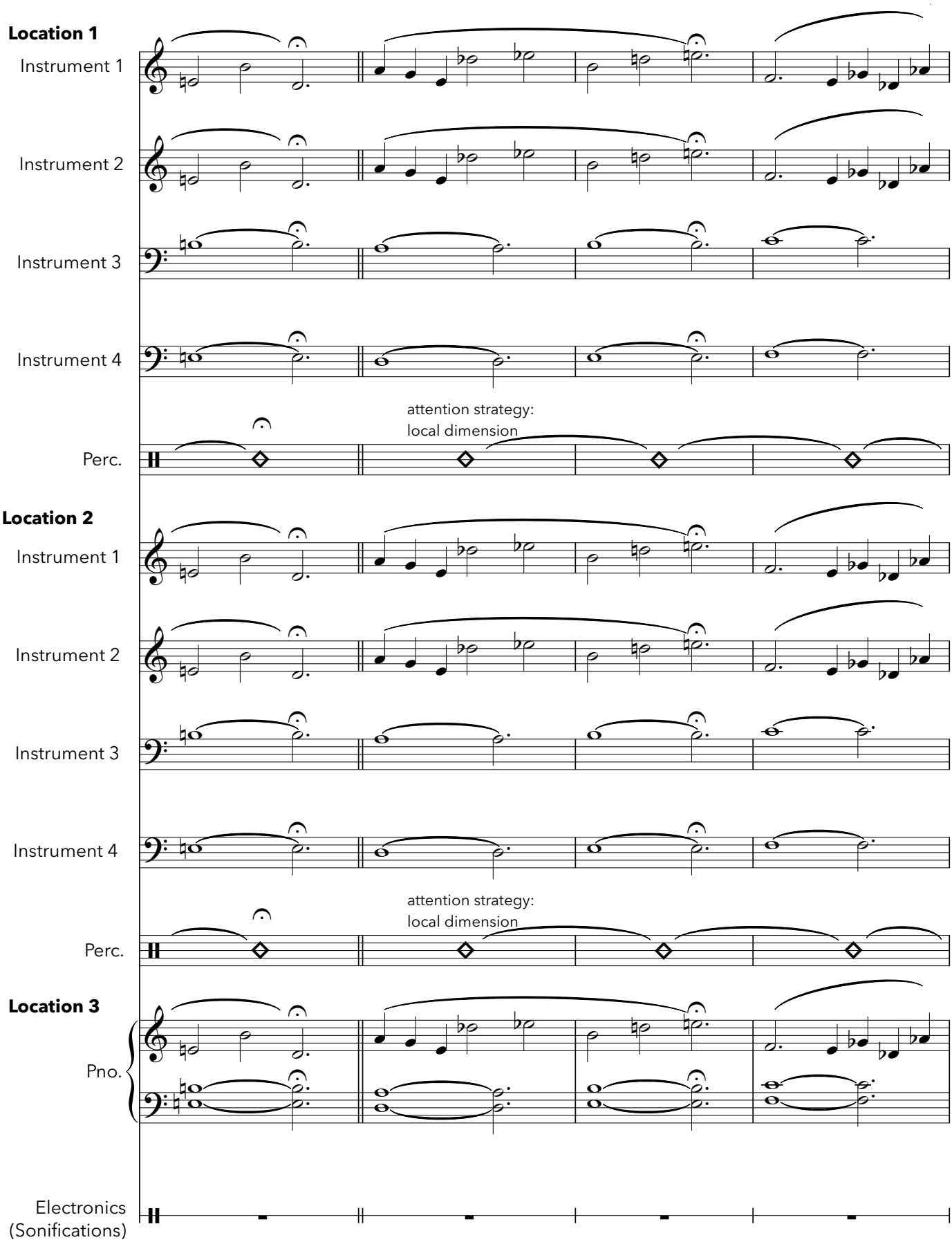
All: Improvisation Solos/Duos Layered On Cue
attention strategy: inner habitable zone
Evolve into Group Improvisation
attention strategy: group habitability

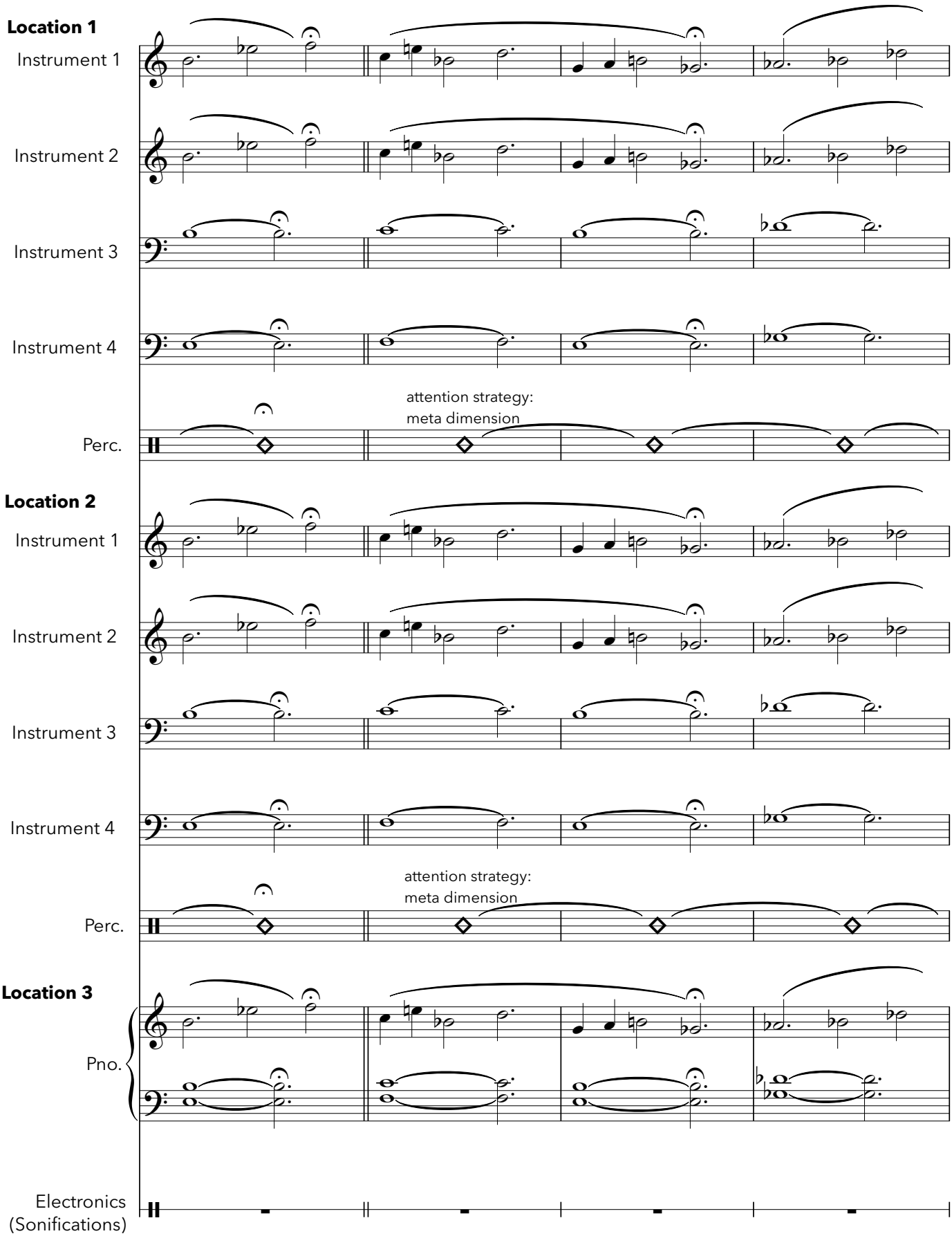
8 ♩= 40 Conductor Gives Four Beats Per Measure and Holds Fermata on Beat Four

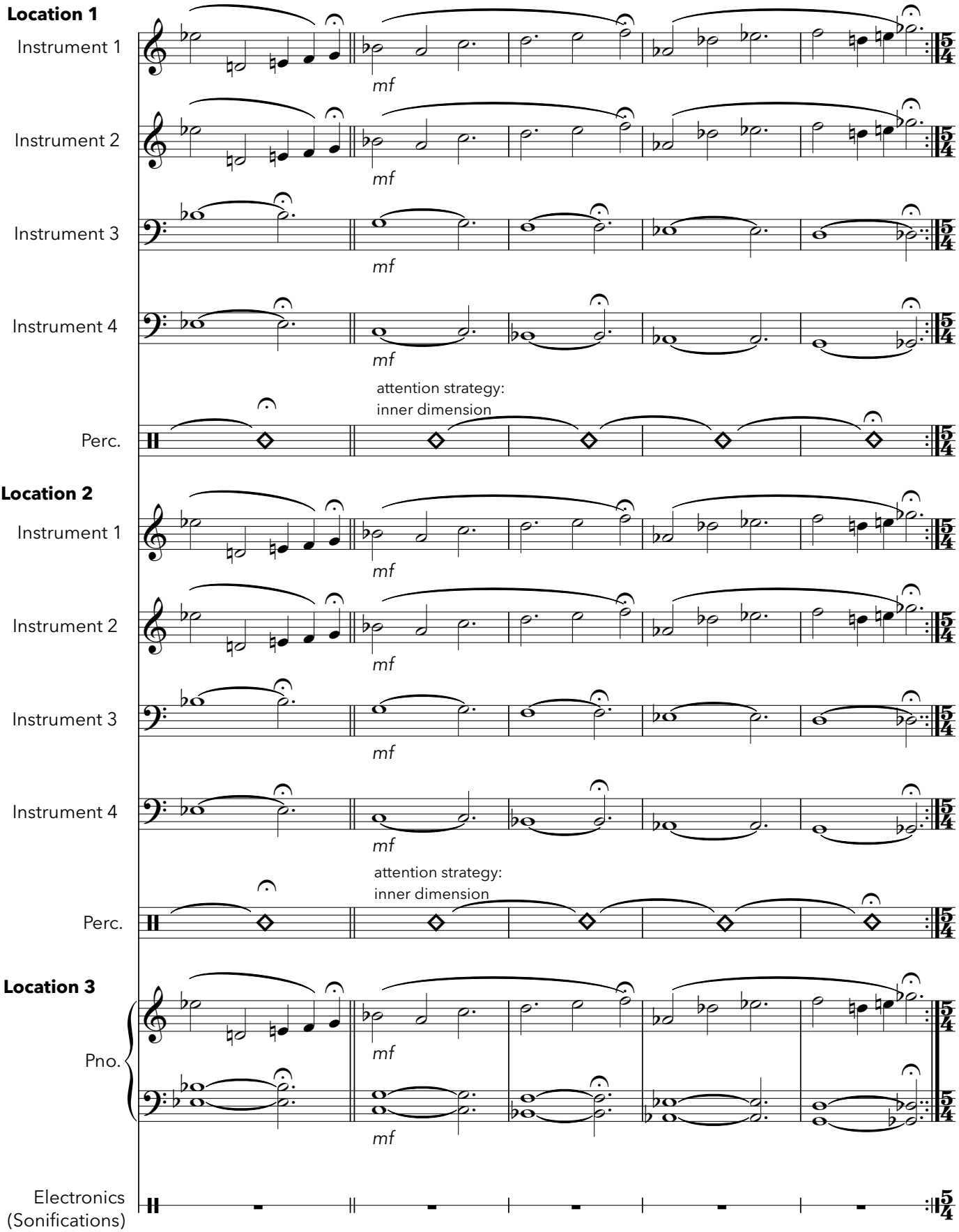


Improvise with: *Sonification 3: Constellations of stars of multiplanetary habitable systems


9
♩= 92 Flexible
Location 1
Instrument 1
mp 1x solo line in trio with cymbals
2x solo improv
Instrument 2
mp 1x tacit, 2x play
Instrument 3
mp 1x tacit, 2x play
Instrument 4
mp 1x tacit, 2x play
attention strategy:
distant dimension
Perc.
p mf
bowed cymbals, ad. lib.
Location 2
Instrument 1
mp 1x tacit, 2x play
Instrument 2
mp 1x tacit, 2x play
Instrument 3
mp 1x tacit, 2x play
Instrument 4
mp 1x tacit, 2x play
attention strategy:
distant dimension
Perc.
mf p
bowed cymbals, ad. lib.
Location 3
Pno.
mp
mp 1x tacit, 2x play
Electronics
(Sonifications)
♩= 92


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
attention strategy:
local dimension
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
attention strategy:
local dimension
Perc.
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
attention strategy:
meta dimension
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
attention strategy:
meta dimension
Perc.
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
mf
Instrument 2
mf
Instrument 3
mf
Instrument 4
mf
attention strategy:
inner dimension
Perc.
Location 2
Instrument 1
mf
Instrument 2
mf
Instrument 3
mf
Instrument 4
mf
attention strategy:
inner dimension
Perc.
Location 3
Pno.
mf
Electronics
(Sonifications)

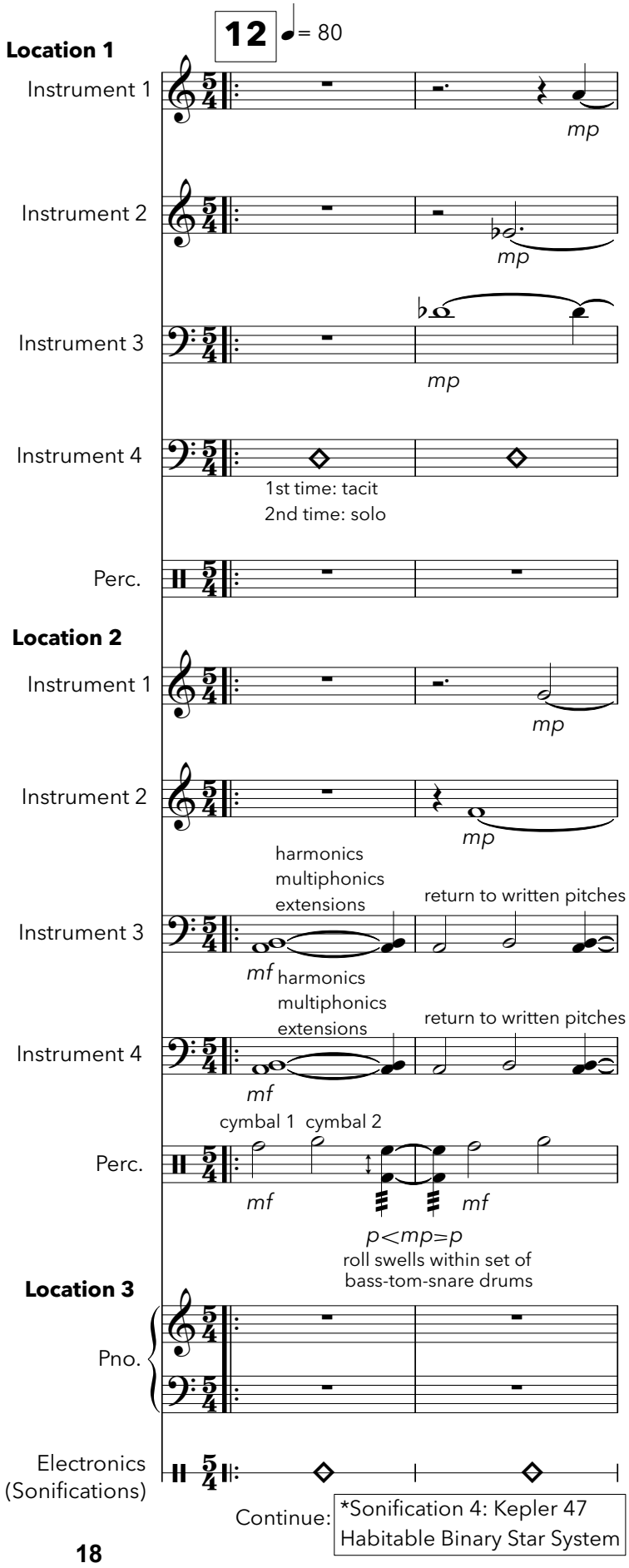
10 Time: 1 Minute

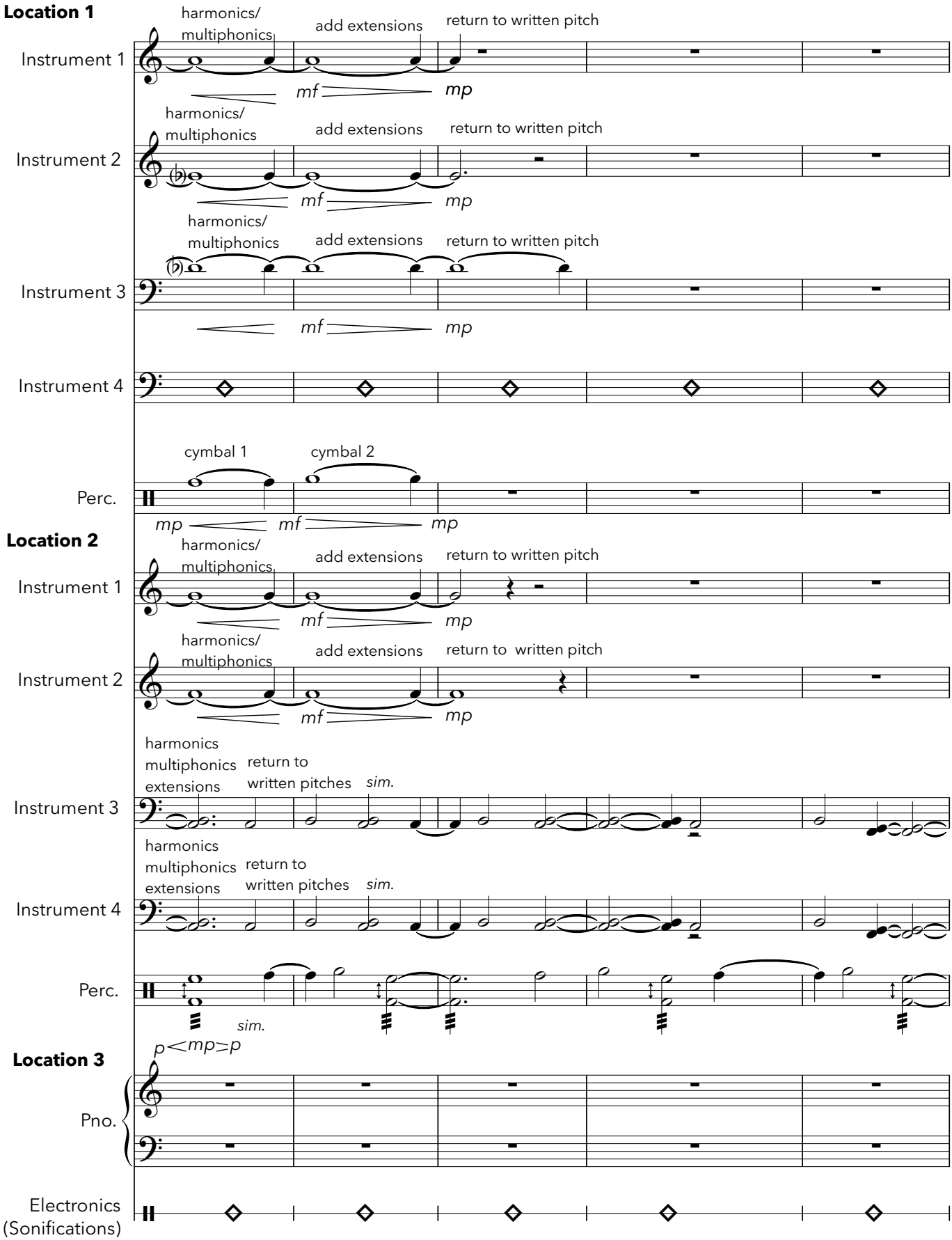
Percussion: Improvisation duet attention strategy: seach for synchrony

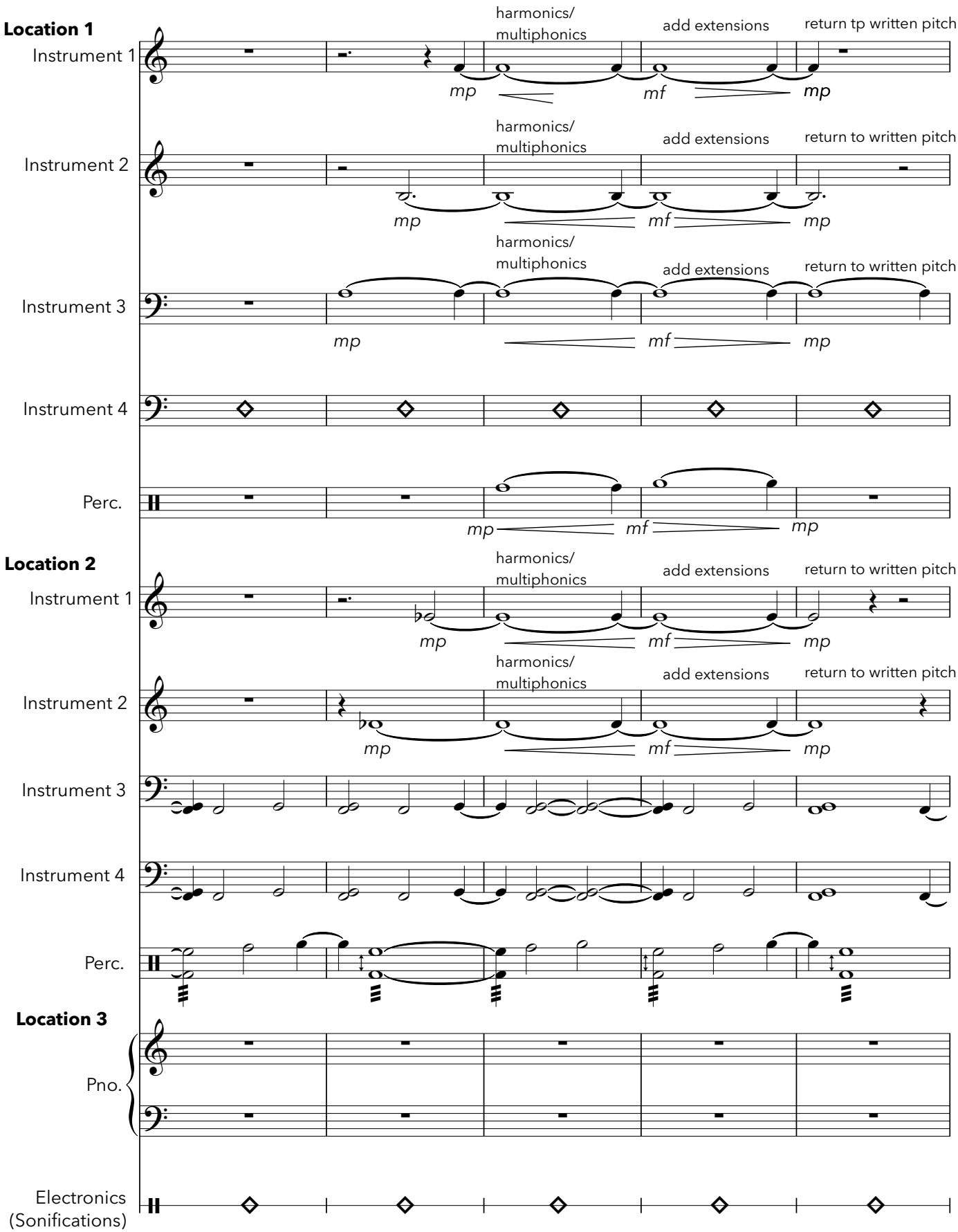
11 Time: 2 Minutes

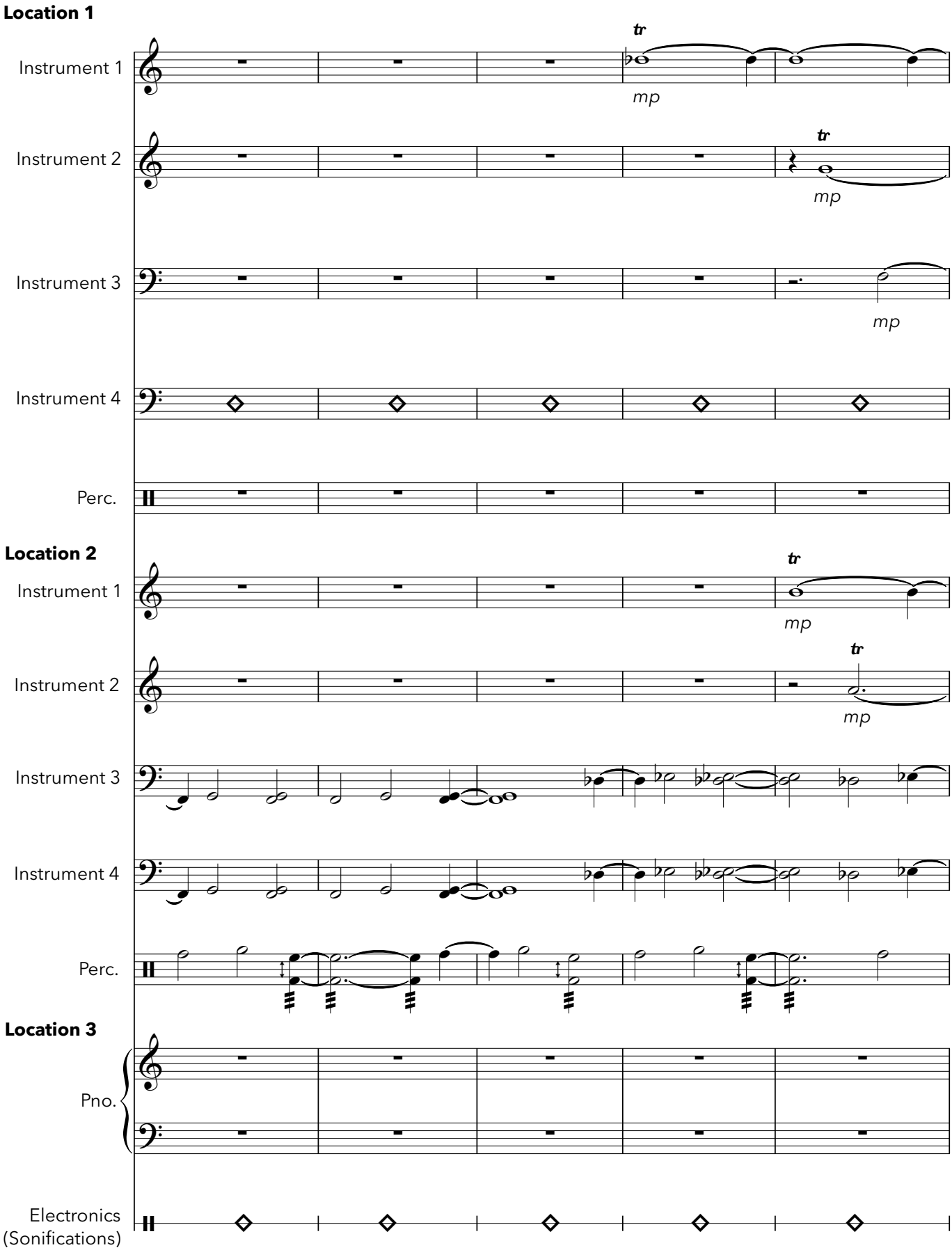
Electronics:

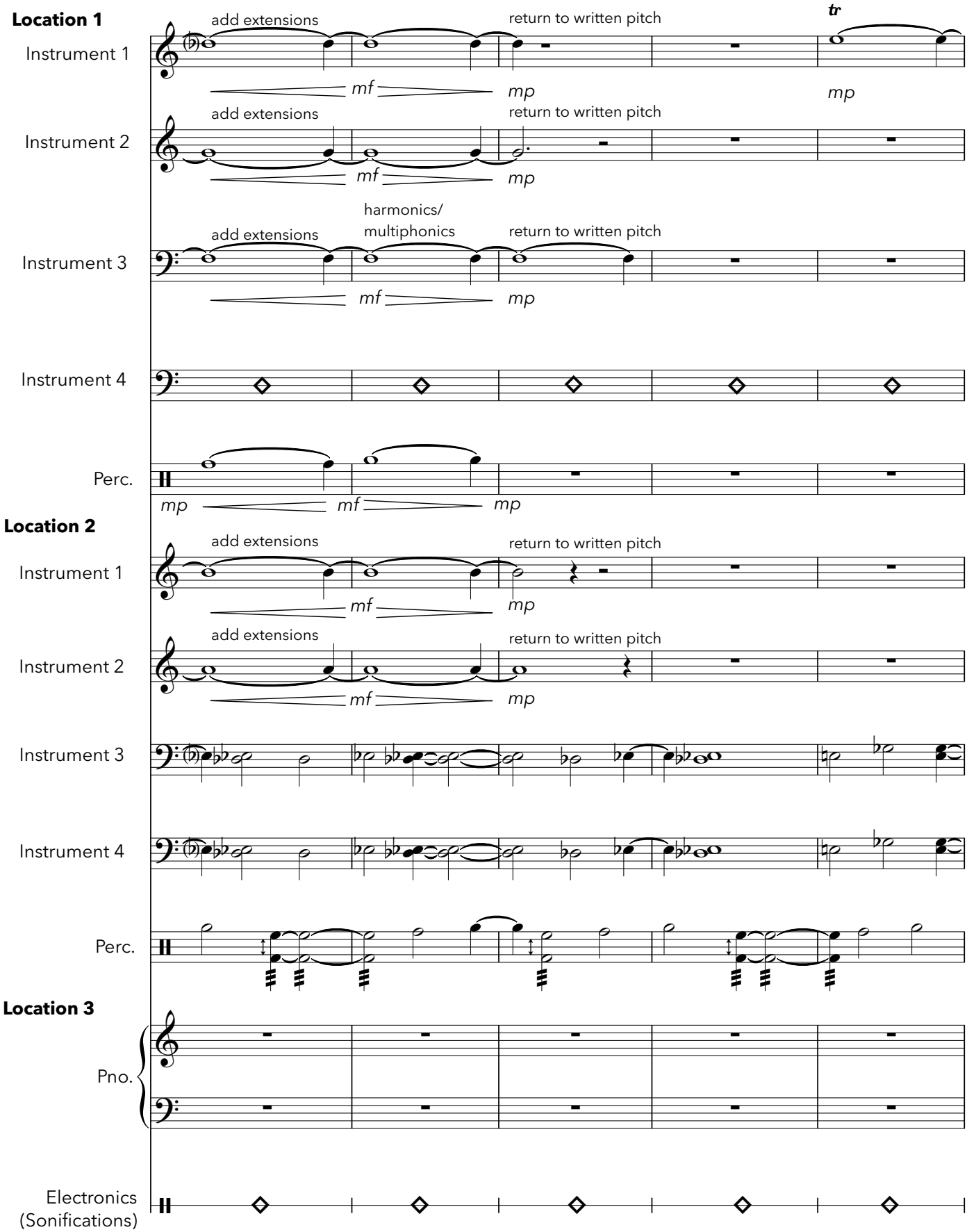
*Sonification 4: Kepler 47 Habitable Binary Star System

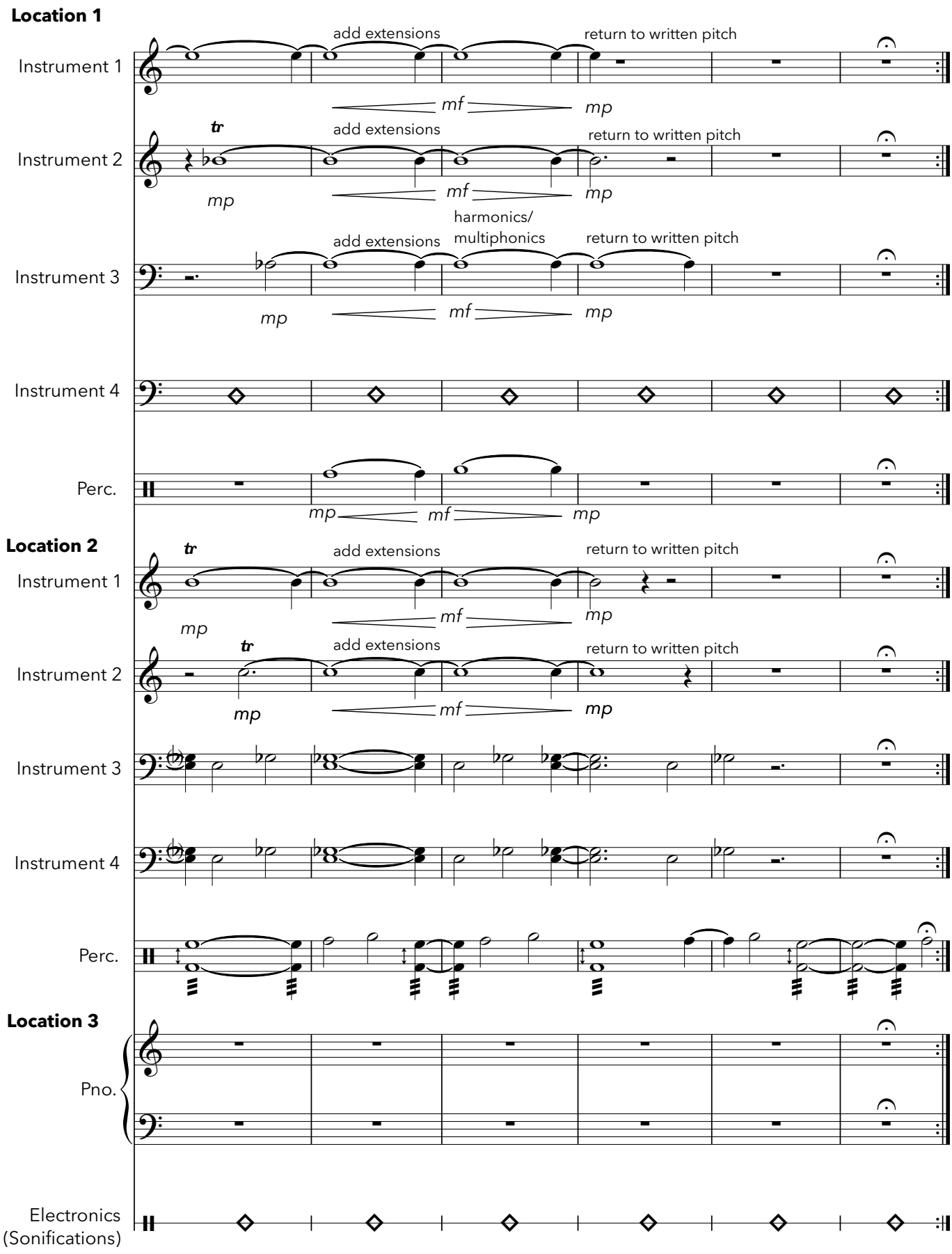



Location 1
Instrument 1
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 2
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 3
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 4
Perc.
cymbal 1
cymbal 2
mp
mf
mp
Location 2
Instrument 1
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 2
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 3
harmonics
multiphonics
extensions
return to
written pitches
sim.
Instrument 4
harmonics
multiphonics
extensions
return to
written pitches
sim.
Perc.
sim.
p<mp>p
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
harmonics/
multiphonics
add extensions
return tp written pitch
mp
mf
mp
Instrument 2
harmonics/
multiphonics
add extensions
return to written pitch
mp
mf
mp
Instrument 3
harmonics/
multiphonics
add extensions
return to written pitch
mp
mf
mp
Instrument 4
Perc.
mp
mf
mp
Location 2
Instrument 1
harmonics/
multiphonics
add extensions
return to written pitch
mp
mf
mp
Instrument 2
harmonics/
multiphonics
add extensions
return to written pitch
mp
mf
mp
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
tr
mp
Instrument 2
tr
mp
Instrument 3
mp
Instrument 4
Perc.
Location 2
Instrument 1
tr
mp
Instrument 2
tr
mp
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)

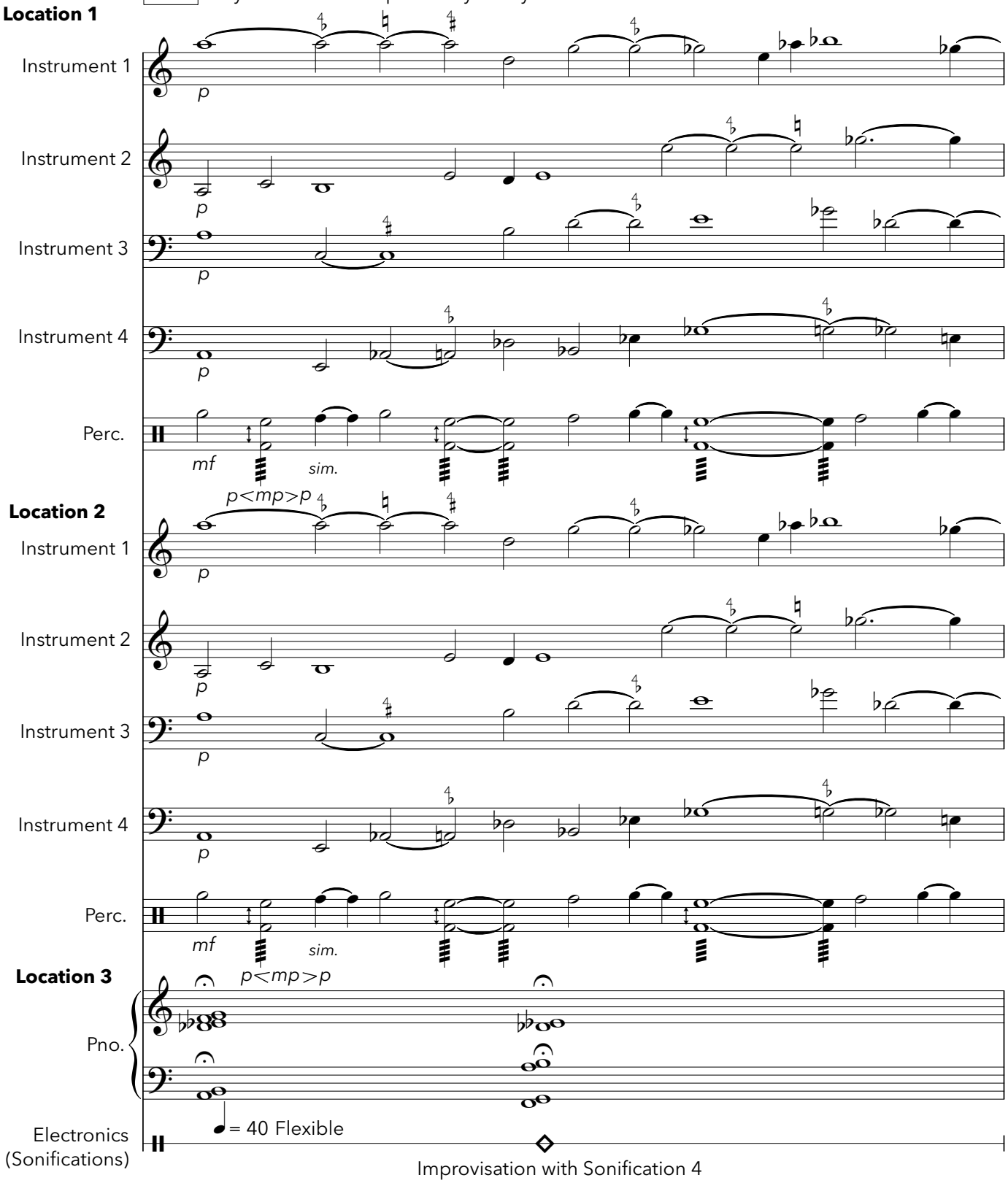

Location 1
Instrument 1
add extensions
return to written pitch
tr
mf
mp
mp
Instrument 2
add extensions
return to written pitch
mf
mp
Instrument 3
harmonics/
multiphonics
add extensions
return to written pitch
mf
mp
Instrument 4
Perc.
mp
mf
mp
Location 2
Instrument 1
add extensions
return to written pitch
mf
mp
Instrument 2
add extensions
return to written pitch
mf
mp
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)


Location 1
Instrument 1
add extensions
return to written pitch
mf
mp
Instrument 2
tr
add extensions
return to written pitch
mp
mf
mp
Instrument 3
harmonics/
multiphonics
add extensions
return to written pitch
mp
mf
mp
Instrument 4
Perc.
mp
mf
mp
Location 2
Instrument 1
tr
add extensions
return to written pitch
mp
mf
mp
Instrument 2
tr
add extensions
return to written pitch
mp
mf
mp
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)

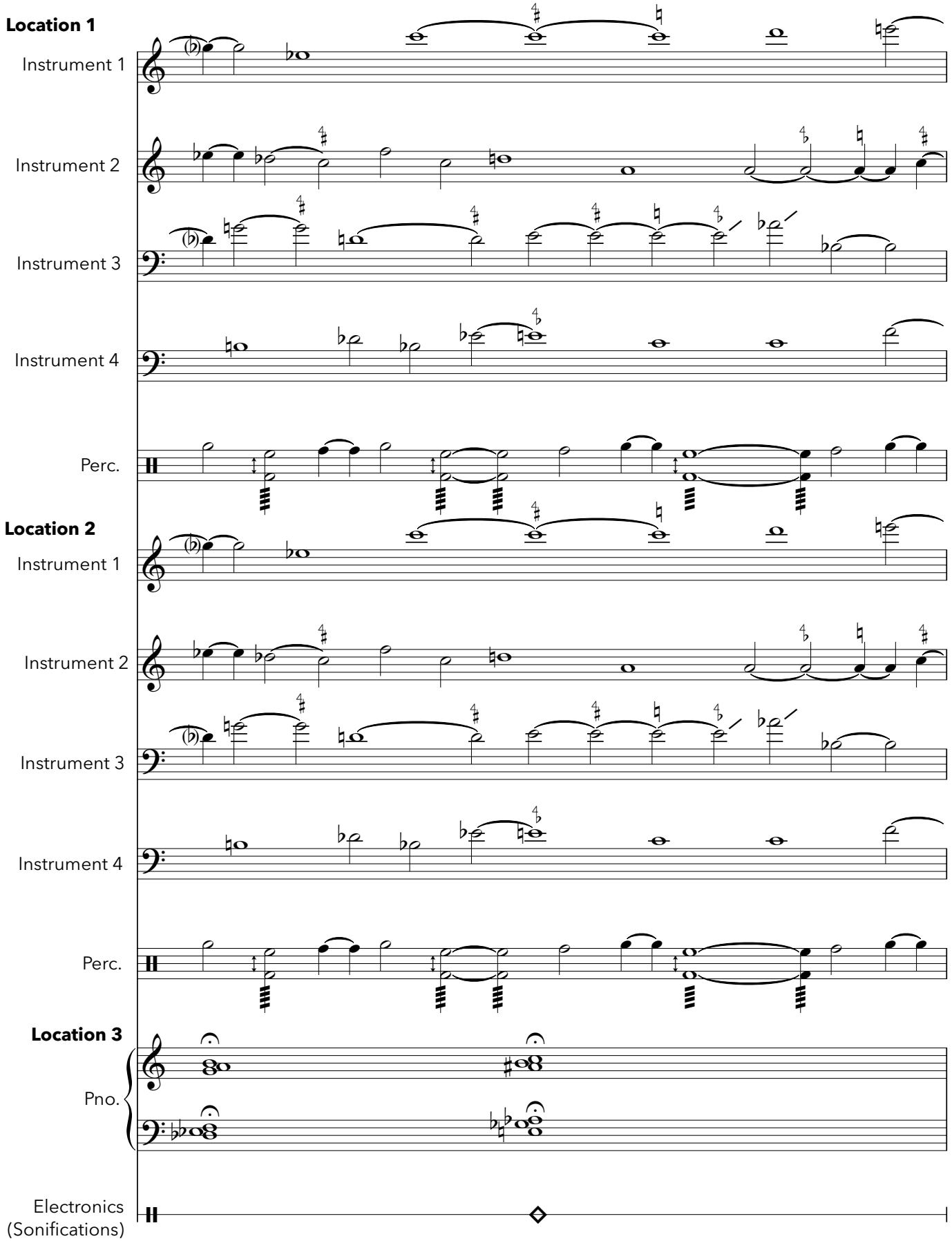
13 Time: 3 Minutes

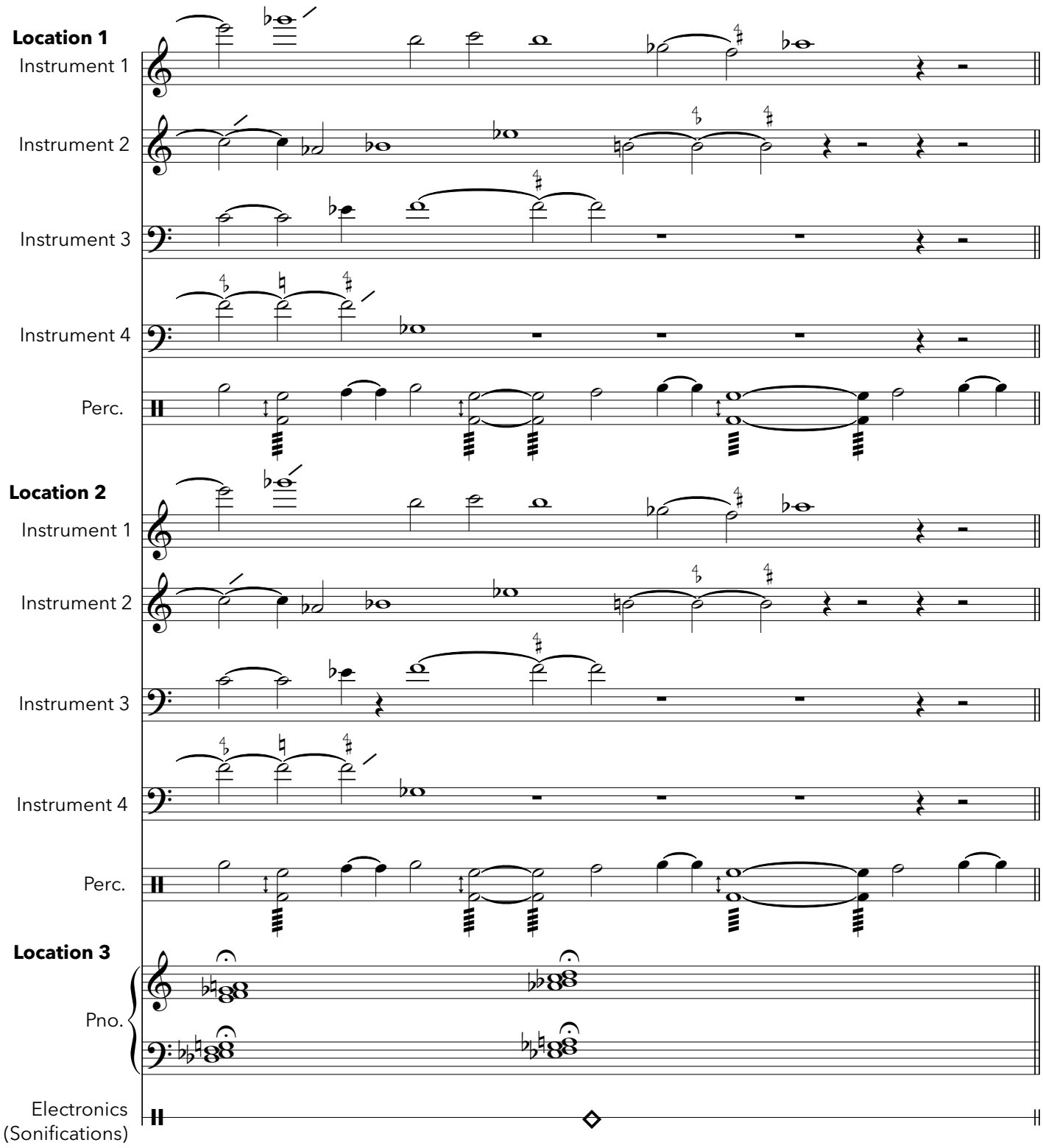
All: On cue, improvise with Palette 12 materials.
attention strategy: habitable zone
Electronics: Record Musicians and Play them back within Sonification 4 timing

14 ♩ = 40 Flexible
Play written line independently for layered ensemble texture



Improvisation with Sonification 4
attention strategy: synchrony


Location 1
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 2
Instrument 1
Instrument 2
Instrument 3
Instrument 4
Perc.
Location 3
Pno.
Electronics
(Sonifications)



15 Time: 3 Minutes

All: Improvise with materials from Palette 14.

attention strategy: synchrony

FIN